FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Feed the Future Mali Livestock Technology Scaling program (FTF-MLTS)

Annual report

2018

USAID
FROM THE AMERICAN PEOPLE

Feed the Future Mali Livestock Technology Scaling Program (FTF-MLTS)

Annual report

2018

ILRI thanks all donors and organizations which globally support its work through their contributions to the CGIAR Trust Fund

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover image—ILRI/Stevie Mann

Citation: International Livestock Research Institute (ILRI). 2019. *Feed the Future Mali Livestock Technology Scaling Program (FTF-MLTS) annual report 2018*. Nairobi, Kenya: ILRI.

Patron: Professor Peter C Doherty AC, FAA, FRS
Animal scientist, Nobel Prize Laureate for Physiology or Medicine–1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa

Contents

Figures

Tables

Disclaimer

This report is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the Feed the Future (FTF) initiative. The contents are the responsibility of the International Livestock Research Institute (ILRI) and do not necessarily reflect the views of USAID or the United States Government.

Acronyms and abbreviations

AMEDD	Association Malienne d'Eveil au Développement Durable
AVSF	Agronomes et Vétérinaires sans Frontières
AU-PANVAC	Pan African Veterinary Vaccine Center of African Union
BoA	Bank of Africa
CAHP	Community Animal Health Platform
CAHW	Community animal health worker
CBPP	Contagious bovine pleuropneumonia
CNASA	Centre National d'Appui à la Santé Animale
COVEM	Collectif des Vétérinaires Mandataires
CRS	Catholic Relief Services
DD	Due diligence
DNPIA	Direction Nationale des Productions et Industries Animales
DNSV	Direction des Services Vétérinaires
DQA	Data Quality Assessment
EMMP	Environmental Monitoring and Mitigation Plan
FAO	Food and Agriculture Organization of the United Nations
FCFA	CFA franc
FEAST	Feed Assessment Tool
FEBEVIM	Federation of Cattle and Meat of Mali
FFSWE	Finance for Food Security and Women Entrepreneurship
FTF	Feed the Future
FTF-MLTS	Feed the Future-Mali Livestock Technology Scaling
FY	Fiscal year
ha	Hectare
ICRISAT	CGIAR International Crops Research Institute for the Semi-Arid Tropics
IER	Instituit d'Economie Rurale
ILRI	International Livestock Research Institute
IP	Innovation platform
kg	Kilogram
L4G	USAID Livestock for Growth
LCV	Laboratoire Central Veterinaire
LMIS	Livestock Market Information System
MEL	Monitoring Evaluation and Learning
ml	Millilitres

MLTS	Mali Livestock Technology Scaling
NGO	Nongovernmental organization
OMA	Observatoire du Marché Agricole
PAMF	Premiere Agence de Microfinance-First Microfinance Agency
PM	Program manager
PMO	Program management officer
PMP	Performance Management Plan
PMU	Program management unit
PPR	Peste des petits ruminants
PRAPS	Projet Regional d'Appui au Pastoralisme dans le Sahel
SMS	Short message service
SNV	Netherlands Development Organisation
t	Tonne
ToRs	Terms of references
TLU	Tropical Livestock Unit
PTAC	Program Technical Advisory Committee
USAID	United States Agency for International Development
USD	US dollar
USG	US government
WTP	Willingness to pay
ZOI	Zone of Influence

Executive summary

FTF-MLTS is aligned to the USAID/Mali FTF program and more specifically to the Mali FTF livestock value chain component initiated to boost growth of the Mali livestock sector. The overarching goal of FTF-MLTS is to contribute to the inclusive growth in ruminant livestock value chains for increased income, food and nutrition security for 266,000 cattle, sheep and goat keepers and other value chain actors in the Mopti, Timbuktu and Sikasso Regions, hence lifting people out of poverty. The FTF-MLTS program aims to bridge ruminant livestock productivity gaps and to improve access to more remunerative markets through a large-scale dissemination of proven livestock technologies and best practices in the target regions. This report highlights FTF-MLTS implementation, achievements and challenges encountered during fiscal year 2018 (FY18).

Program management

Contractual arrangements with implementing partners: ILRI continued its collaborative work with technical partners and nongovernmental organizations (NGOs) to implement FTF-MLTS. In FY18, eight collaborative agreements with main implementing partners were renewed through amendments of their subawards.

Reduce disease burden in ruminant livestock through innovative animal health delivery systems and best health interventions

Pestes des petits ruminants (PPR) thermostable vaccine: Overall, significant progress was made in the production and use of PPR thermostable vaccines. The tests conducted demonstrated that the Laboratoire Central Veterinaire (LCV) Xerovac vaccine batch is the most thermostable of the three batches, followed by the IRLI batch, while the LCV Classic batch was not thermostable. According to the Food and Agriculture Organization of the United Nations' (FAO) and Organisation Internationale des Epizooties (OIE) recommendations, a PPR vaccine is thermostable when it has a minimum acceptable titer at 25°C for 10 days or 40°C for two days. Considering this, both vaccines based on LCV Xerovac and ILRI protocols largely meet the standards and are therefore thermostable and could be deployed in the field. However, to obtain better quality vaccines with lower residual moisture and to increase shelf life of the ILRI vaccine, a second batch of 120,000 doses was produced using an improved lyophilizing process. The batch has successfully passed all internal and external quality tests at LCV and Pan African Veterinary Vaccine Center of African Union (AU-PANVAC), respectively (see Annexe 1).

Significant improvement in vaccination coverages: Compared against baseline data, vaccination coverage improvement was achieved for all target diseases. Out of a target cattle population of 262,930 head, 173,756 (66%) have been protected against contagious bovine pleuropneumonia (CBPP). A total of 66,780 (25%) of the target cattle population have been protected against bovine pasteurellosis. The number of sheep and goats vaccinated against PPR reached 153,675 (75.7%) out of a combined target sheep and goat population of 203,105, compared against a baseline vaccination coverage of 5% for PPR.

Knowledge, skills and organizational capacities of livestock producers improved significantly: Innovation platforms (IPs) played a critical role in the project implementation strategy. During the project implementation, IPs served as a key mechanism to organize value chain actors that enabled the increase of vaccination coverage, the dissemination of forage varieties among producers, the support of cross-border livestock trade fairs, and the diversification of sources of income for women through the development of feed value chains. Capacity building of extension agents and community animal workers has been key to improving producer access to quality veterinary services. FTF-MLTS invested in training community animal health workers (CAHWs) and veterinary services staff who subsequently trained producers on disease control, food safety, and livestock management and health treatment best practices. Formal training of farmers on animal health and food safety were carried out together under the integrated technological package concept. In total, 2,697 (554 women) producers were trained in various topics regarding animal health and food safety. Furthermore, short training through awareness-raising campaigns were carried out especially with regard to vaccination and disease control. Ninety-two groups of farmers were educated on the importance of vaccination against PPR, PPCB, and bovine and ovine pasteurellosis in areas covered by Association Malienne d'Eveil au Développement Durable (AMEDD); 1,855 producers in Catholic Relief Services (CRS) areas and 2,055 producers in Netherlands Development Organisation (SNV) areas. During FY18, FTF-MLTS invested in

increasing knowledge and skills of 9,204 farmers on forage and fodder production, harvesting, storage and seed production techniques.

Significant increase in the availability of quality feed biomass in target communes to support growth in livestock productivity through fattening and stimulate the emergence of feed value chains

Food feed and forages crops: The overall quantity of biomass produced from all fodder/forage varieties introduced by FTF-MLTS and grown in the project areas is estimated at around 12,500 tonnes (t) of dry matter during FY18. This amount of feed provides 28,000 head of cattle their dry matter requirements for three months during the dry season. Moreover, thanks to rationing practices based on integrated technology practices adopted by producers after project-sponsored training modules, , agro-pastoralists were able to enhance the value of the feedstuff produced by combining it with other on-farm feed resources.

Integrated technological packages: Integrated packages are bundles of animal health and feed technologies combined with best husbandry practices designed to support cattle and sheep intensified-production models that improve productivity and profitability of livestock enterprises. They are tailored to specific production objectives including cattle and sheep fattening, dry season strategic supplementation of lactating cows and better management of cattle used for draught animals. In the project area covered by CRS and SNV in Mopti and Sikasso during FY18, 3,609 sheep and 2,725 cattle were fattened and sold.

Support to feed processing units: The capacities of seven women groups in Sikasso and Timbuktu were strengthened regarding the use of grinders to produce densified livestock feed from cereal crop residues and multi-nutrient blocks. For instance, the Zangasso cooperative produced 1,697 blocks of 3 kilograms (kg) each that were sold at 1.9 million CFA franc (FCFA). The members (25 women) of Kouoro IP produced both multi-nutrients blocks and densified and fortified feeds from cereal crop residues valued at FCFA 4.5 million with a total net benefit estimated at FCFA 1.5 million.

Revitalize the Livestock Market Information System (LMIS) to capture market incentives

Upgrade LMIS: During FY18, Texas A&M AgriLife updated the LMIS Version 4 software to accommodate data transfer functions and administrative oversight. An alpha version of a buy/sell module was added to the system. Improvements to the data transfer functions included error trapping for users entering incorrect dates. Modifications were also made to the LMIS website front page to show prices that have been collected during the last 14 days and to show 'no report' for active markets that have not reported data during the last 14 days. For the alpha version of the buy/sell capabilities, a module was developed that allows web users to enter information into the website on animals that they would like to buy or sell.Training was provided to Observatoire du Marché Agricole (OMA) on server administration and database maintenance for the new version.

Livestock information system use and analytics: With regard to messages received by the server where users made a request for market information via short message service (SMS), the average number of requests per month was 114 for FY18 and on average, 39 unique users accessed the website each month.

Improve LMIS operations: The collection and transmission of data from 17 target livestock markets were carried out by enumerators. Since January 2018, 35 additional livestock markets have been monitored by the Projet Regional d'Appui au Pastoralisme dans le Sahel (PRAPS) project. During FY18, 960,251 head of cattle were offered on all 17 markets monitored under FTF-MLTS, out of which 600,293 were sold. For sheep, 983,934 head were presented, out of which 527,901 were sold. For goats, 855,589 head were presented and 542,720 were sold. The dissemination of livestock market information through radio stations is ongoing. Market enumerators and radio directors and broadcasters are working together to disseminate livestock market information through rural radio stations every week. During this period, 22 radio presenters were trained to better understand the system and disseminate livestock market information towards the population. Information on average animal prices by species, breed, category, gender, and conformation is available and accessible from cell phones and on the website www.malibetail.net. The requests on the server from the cell phones of the majority of applicants have increased especially with the start of the activities of the PRAPS project.

Facilitating the development of competitive cattle and sheep production and marketing models

One objective of FTF-MLTS is to support the competitiveness of family-based cattle and sheep fattening enterprises to improve their further penetration in domestic and export livestock markets.

Link fatteners with financial institutions: FTF-MLTS and Finance for Food Security and Women Entrepreneurship (FFSWE) worked together to facilitate access by ruminant livestock value chain actors to financial institutions for credit needed to finance their operations. Overall, a total of 34 livestock-based loan applications with a total amount of FCFA 128.2 million (223,204 US dollar (USD)) were processed by financial institutions (Banque International pour le Mali (BIM), Bank of Africa (BoA) and microfinance organizations including Kafo Jiginew, MicroCred and Premiere Agence de Microfinance-First Microfinance Agency (PAMF)). To date, twelve applications (FCFA 17.7 million, USD 32,034) have been approved. It is worth noting that microfinance institutions are more flexible than banks with regard to providing loans to livestock value chain actors. A limited number of applications to BIM and BoA were approved. Thus far, only one application for for a loan by a private veterinarian (Sikasso and Farakala 'agent') has been approved by BoA.

Organize livestock trade fairs in cross-border markets for the promotional sale of sheep for the Tobaski: FTF- MLTS supported the organization of cross-border trade fairs during Tobaski, a major Islamic holiday, to increase livestock supply from project target communes. In partnership with the Federation of Cattle and Meat of Mali (FEBEVIM), cross-border livestock trade fairs were organized in the communes of Kourémalé and Siékorolé targeting Guinea export markets. The two-week monitoring of livestock trade transactions in the two livestock markets indicate that a total of 5,050 small ruminants were presented on the two border-markets. During the two weeks prior to the Tobaski celebration, 2,451 sheep and 727 goats valued, respectively, at FCFA 172,816,250 and FCFA 28,661,625 were sold and exported to Guinea.

Facilitate commercial relations between fatteners and buyers: Efforts were made to link up Laham Industrie, a modern Halal abbatoir, with livestock producers in the Sikasso Region. Agreements were reached to send convoys of well-finished animals to Laham but Laham was undergoing cash shortages and could not honor its commitments. The study carried out by FTF-MLTS on 'Perspectives on the competitiveness of live animal versus meat exports in Mali' during FY18 revealed that the fundamental constraint in Sahelian and west African markets is a lack

of product differentiation, stemming from an imbalance in demand, lack of market access and underdevelopment of market opportunities. The strategy that innovative abattoirs like Laham are pursuing is a sensible one. However, significantly more work will be needed to develop segmented markets for beef at end-consumer level alongside production and marketing strategies that can facilitate the sale of cheaper offals to consumers. Focusing on the supply side is not sufficient—a demand-driven strategy led by buyers is key. There is a demonstrated very strong interest in trading and selling meat from the Sahel to the coast, but this requires market development and differentiation on the one hand with the ability to produce and sell frozen offals to a broader consumer base on the other.

Gender-related achievements and how gender is mainstreamed into activities

In general, women have been empowered through their active participation in all capacity-building interventions including training to develop their technical, managerial, and organizational knowledge and skills on forage and fodder production, animal health and integrated packages. Women's groups were also particularly targeted in the establishment and operation of feed processing and marketing units. In the Mopti Region, 30% of the project beneficiaries are women (961 out of 3,239 producers). In Sikasso and Djenne, in target communes covered by SNV, 166 women members of the feed cooperatives participated in the manufacturing of multi-nutrient blocks and animal feeds from cereal crop residues. In 12 Sikasso target communes under AMEDD, a total of 1,096 farmers were trained including 383 women. One important aspect of women's empowerment dealt with the vaccination of sheep and goats which are livestock assets mainly owned by women. At baseline, only 5% of sheep and goats were vaccinated in the project sites against PPR. The establishment of IPs promoted the involvement of women in all project interventions with the intent to specifically benefit them. By the third year of project implementation, vaccination against PPR reached 75%.

Background

The FTF-MLTS program seeks to contribute to the inclusive growth of the ruminant livestock value chain for increased income, food and nutrition security for 266,000 cattle, sheep and goat keepers and other value chains actors in three regions of the country (Mopti, Timbuktu and Sikasso), hence lifting people out of poverty. Supported by USAID as part of the US Government's FTF initiative, the program intends to bridge ruminant livestock productivity gaps and to enhance the volume and value of ruminant livestock marketed through a wide-scale dissemination of proven livestock technologies and best practices. The program is implemented by ILRI working with a consortium (Table 1) of public institutions (Direction Nationale des Services Veterinaires, Direction Nationale des Productions et Industries Animales, LCV, Instituit d'Economie Rurale (IER), private sector organizations (private veterinarians, feed manufacturers) and NGOs such as CRS, SNV, AMEDD and the Agronomes et Vétérinaires sans Frontières (AVSF). FTF-MLTS also collaborates with ongoing FTF projects such as Livestock for Growth (L4G) and other rural development programs in Mali that are pursuing similar objectives in order to create synergies among them.

FTF-MLTS has a zone of influence spanning 31 target communes in the Mopti, Timbuktu and Sikasso Regions. The project has extended to a new municipality (Madiama) and 21 new villages in the Region of Mopti in the area covered by CRS. In the entire intervention area, there was an upward trend in the number of beneficiaries, increasing from 5,653 in fiscal year 2017 (FY17) to 10,552 in FY 2018, an increase of 4,899 new beneficiaries(46.42%).The present report highlights activities, achievements and challenges faced in rolling out project interventions, and lessons learned during the course of FY18.

Table 1. List of implementing partners and their geographical focus

Organization	Region	Cercle	Communes
1.AMEDD	Sikasso	Koutiala	81. Sinkolo, 82. Zangasso, 83. Kapala, 84. Nguntina, 85. Koloningue, 86. Nafanga
2. SNV	Sikasso	Sikasso	47. Kouoro, 58. Natien, 59. Farakala
	Mopti	Mopti	28. Soye, 29. Sio;
		Djenne	17. Femaye, 107. Fakala, 108. Djenne
3. CRS	Mopti	Mopti	34. Socoura
		Djiene	107. Fakala
4.AVSF	Timbuktu	Nyafunke	97. Soumboudou, 98. Soumpi, 113.Alafia, 103. Timbuktu, 100. Douekire, 101. Kaneye
5. OMA/DNPIA*	17 livestock markets monitored		
7. IER	Crosscutting		
8. LCV	Crosscutting		
9. COVEM**/ ANAVEM***	Crosscutting		
9. DNSV****/ CNASA*****	Crosscutting		

*Direction Nationale de la Production et des Industries Animales (DNPIA)

**Collectif des Vétérinaires Mandataires (COVEM)

***Association Nationale des Vétérinaires Mandataries (ANVEM)

****Direction des Services Vétérinaires (DNSV)

*****Centre National d'Appui à la Santé Animale (CNASA)

Progress during the reporting period

Contractual arrangements with implementing partners

ILRI continued its collaborative work with technical partners and NGOs to implement FTF-MLTS. In 2018, eight collaborative agreements with main implementing partners were renewed through amendments of their subawards. These implementing partners are: CRS, SNV, AMEDD, AVSF, LCV, OMA, DNSV and COVEM, an association of private veterinarians in Mali.

Development of work plans

The third FTF-MLTS program annual planning meeting was held on 18 August–20 September 2018 in Segou with the participation of all implementing partners and other livestock development projects pursuing similar or complementary objectives such as L4G, PRAPS and Programme d'Appui aux Filières Agropastorales de Sikasso. The workshop aimed at making an assessment of achievements and to draw lessons learned over the first three years of the project. A central objective of the workshop was also to consult with all partners to develop strategies to sustain the project achievements and good practices beyond the lifetime of the project.

Open day: The purpose of the FTF-MLTS program open day was to expand the visibility of the program at the local and national levels and to share with all the participants not only project achievements and lessons learned but also the constraints met during the implementation of the activities to inform the direction of interventions during the remaining life time of the project. The participants were the representatives of USAID, producers (members of the IPs), administrative officers (governor, subprefect), national directorates (DNSV, DNPIA), elected representatives of Sikasso and Koutiala (regional counsel, district counsel, commune counsel), technical staff from DNPIA, UAPIA, DRSV, extension organizations (CMDT), implementing partners , USAID-funded projects (L4G, Harande, Mali Cereal Value Chain, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)), newspapers and television networks (ORTM, Africable, AMAP). The representatives of the various livestock value chain actors, NGO partners, public organizations and the private sector appreciated this initiative. About 400 people from Farakala and surrounding villages attended the field visits. The main recommendations formulated by the participants are the following:

- There is a risk of losing the experiences gained and achievements of FTF-MLTS given the short time left to reach the end of the project. As a result, the continuation of the financing of the project is strongly recommended.
- Intensify support to producers by the financial institutions to improve the conditions of access to credit by project beneficiaries.
- Strengthen the project media support towards raising awareness and providing more information to the various target groups.
- Increase support and strengthen the establishment of a sustainable *Brachiaria* seed system as producers place a lot of hope on this forage crop to alleviate dry season feed constraints.
- Plan mechanisms and develop means to make feed grinders easily accessible to a larger number of women's groups and support women's groups in the operation of small-scale feed processing units to go to scale in producing and marketing feed blocks and compound feeds.

Data Quality Assessment (DQA): USAID through the MSI conducted office and field DQA activities with beneficiary populations in the villages of Sofara (Fakala commune) and Dio (Sio commune) in the Mopti Region. The objective was to ensure the effectiveness of the five criteria: validity, integrity, accuracy and feasibility over time. At the end of the process, recommendations were made: i) the archiving of hard copy and electronic project documents and ii) improving the involvement of target groups in the archiving of project documents (monitoring indicators and attendance lists). The DQA focused on the following indicators:

- EG.3.2-1 Number of individuals who have received US Government (USG)-supported short-term agricultural sector productivity or food security training
- EG.3.2-17 Number of farmers and others who have applied new technologies or management practices with USG assistance
- EG.3.2-18 Number of hectares (ha) of land under improved technologies or management practices with USG assistance
- EG.3-9 Number of full-time equivalent jobs created with USG assistance

Objective 1. Promote innovative animal health delivery systems and best practice health interventions to reduce disease burden in ruminant livestock

Produce and deliver a thermostable vaccine against PPR

The key contribution of LCV to FTF-MLTS is the production and field deployment of the PPR thermostable vaccine in partnership with Hester Bioscience Limited, India using the thermostabilization protocol developed by ILRI. The specific objectives for FY18 were: 1) to complete thermostability tests of the batches of 400,000 doses of PPR vaccines produced in 2017 using ILRI and Xerovac protocols, 2) to produce a new batch of 120,000 doses of PPR vaccines using improved lyophilizing protocols to reduce moisture content and perform internal and external quality controls on this batch and 3) to deploy the PPR thermostable vaccine in the field for large-scale vaccination of small ruminants in the project sites.

Quality control and thermostability testing

In 2017, three batches of 400,000 doses each of PPR thermostable vaccine using ILRI Xerovac and thermolabile protocols were produced. In 2018, vaccines were subjected to internal (at LCV) and external (at AU-PANVAC) quality controls. Results from AU-PANVAC showed that the residual moisture values obtained by thermogravimetry were within range (≤ 3.5%) for the three batches of vaccines and the Spark tester confirmed the presence of vacuum by observing the violet light in the various vials of vaccines, demonstrating that the vaccines passed the external quality control tests. PPR thermostable vaccine using the ILRI protocol was subjected to thermostability testing against current PPR vaccines produced at LCV (LCV Xerovac, LCV Classic) for comparison purposes. The three vaccines differed with respect to the type of stabilizers or lyophilizing procedures used:

- Lot 00 or thermostable ILRI Lot: The stabilizer is lactalbumine sucrose with lyophilizing volume of 02 millilitres (ml).
- Lot 01 or LCV Classic Lot: the stabilizer is trehalose with lyophilizing volume of 01 ml.
- Lot 02 or thermostable LCV Lot (Xerovac): the stabilizer is trehalose with lyophilizing process different from ILRI protocol in 01 ml.

Titers of the tested vaccines were monitored when the vaccines were subjected to different temperatures (37°C, 40°C and 45°C) for a duration of 48 hours, 4, 7, 10, 14, 21, 24 and 28 days. Results of thermostability are shown in Figures 1, 2 and 3.

Figure 1. Titer of the different batches of PPR vaccines at 37°C (100 doses).

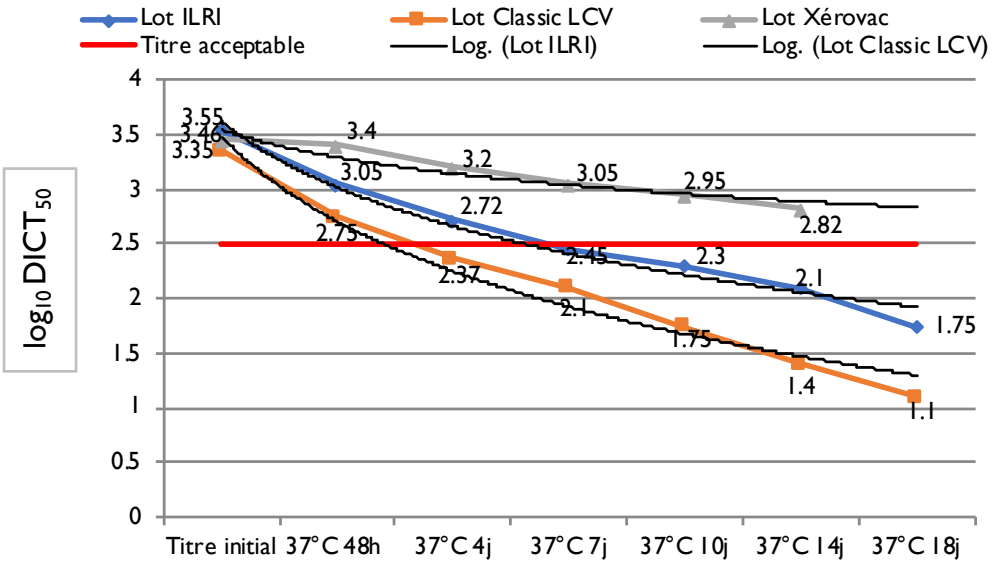


Figure 2. Titer of the different batches of PPR vaccines at 40°C (100 doses).

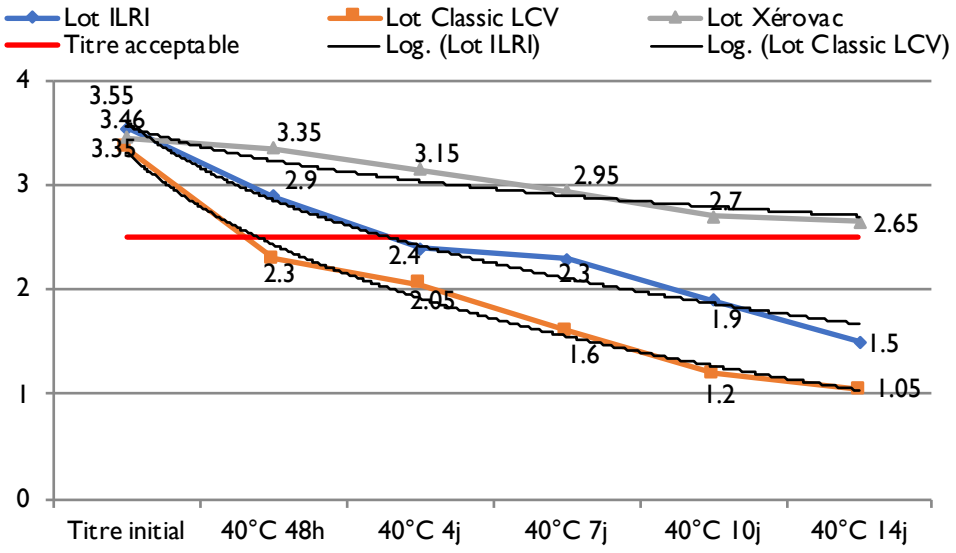
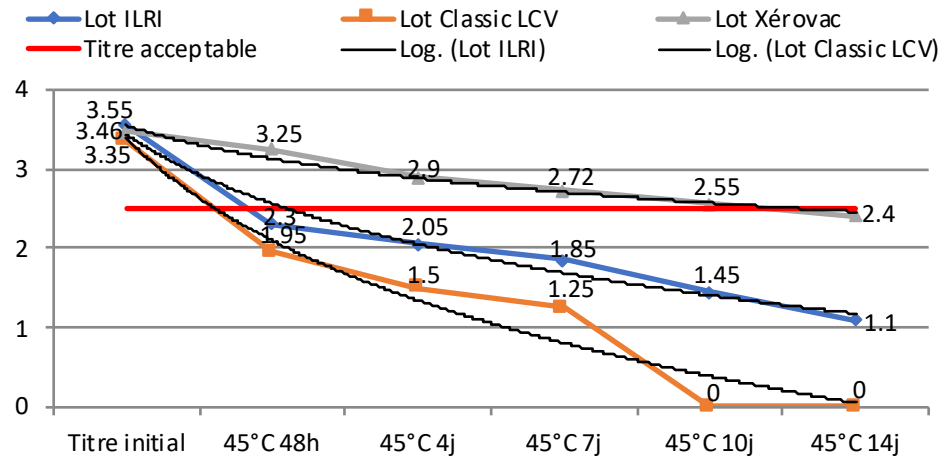


Figure 3. Titer of the different batches of PPR vaccines at 45°C (100 doses).



The titration of the various batches of vaccines after incubation showed that the ILRI batch maintains titer at 37 °C for more than four days but less than seven days, at 40 °C for about four days and at 45°C within 48 hours. However, there is possible influence from the high residual moisture content observed in this batch from the 14th day at different temperatures except at 40°C. This is possibly due to the quality of the bottle covers.

As for the LCV Classic batch, no residual moisture impact was found regardless of the incubation temperatures for 28 days. This vaccine maintained titer only between 48 hours and four days at 37°C and at 40°C or 45°C; the titer is significantly lower at 48 hours.

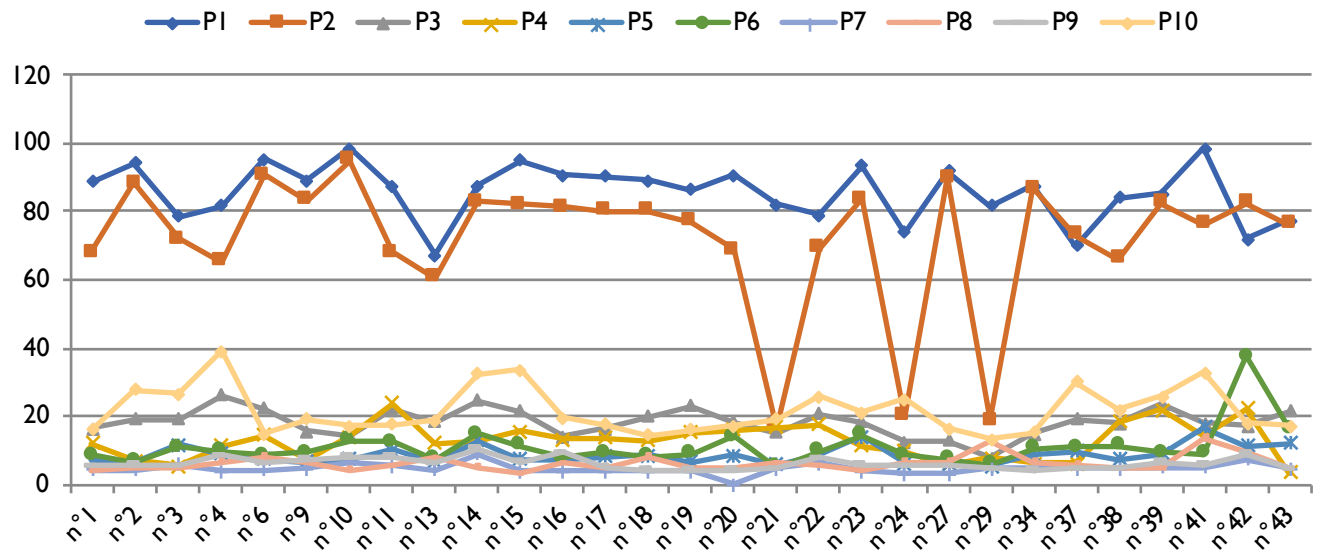
The Xerovac batch has a sufficiently high titer at 37°C and 40°C up to 14 days and possibly beyond if the experiment was continued. These tests show that the LCV Xerovac vaccine batch is the most thermostable of the three batches, followed by the IRLI batch, while the LCV Classic batch is not thermostable. According to FAO recommendations, a PPR vaccine is thermostable when it has a minimum acceptable titer at 25°C for 10 days or 40°C for two days. Considering this, both vaccines (LCV Xerovac and ILRI protocols) largely meet the criteria and are therefore thermostable.

Post-vaccination sero-conversion testing

Further steps were taken to assess the immunogenic properties of the vaccine in animals. Post-vaccination antibody production was measured in animals to evaluate the humoral response of small ruminants. This activity allowed testing the dynamics of antibody response over time. Forty-five small ruminants were acquired in December 2017 and their serum screened for PPR antibodies by cELISA PPR test to attest for absence of PPR by natural infection.

With the first serum samples (P1), all 45 animals were PPR virus seronegative, but at the second confirmation, two sheep and one goat were found to have seroconverted. This situation was followed by the death of a sheep and a goat and was followed by several more mortalities on 19, 22, 25 and 27 January 2018. Following these successive mortalities, samples were taken and analysed by PCR indicating a positive result for PPR virus infection. After laboratory analysis of the third serum sampling round, it was found that all of the animals seroconverted, and overall 16 animals out of 45 died. This means that animals were naturally infected by PPR virus and infection was revealed after purchase when they became sick. The results of the experiments are shown in Figure 4. Given the importance of such a study, it was decided to continue the monitoring of kinetics of antibody up to 12 months post-infection of the naturally infected animals.

Figure 4. The kinetics of the anti-PPR antibodies after a naturally post-infectious state.



Production of an improved vaccine batch

Overall, progress was made in the production and testing of the PPR thermostable vaccine. The aim was to obtain the best quality possible and assess all biological and socio-economic factors that can influence the use of the vaccines in the field. To improve the shelve life of the vaccine and its quality by further reducing the moisture content, a second batch of 120,000 doses of vaccines was produced using an improved lyophilizing process. The batch has successfully passed all internal and external quality tests at LCV and AU-PANVAC (see Annexe 1). Further tests are planned on this batch in 2019, including thermostability testing.

New PPR thermostable vaccine production costs

To guide decision-making during the field deployment of the vaccine, the assessment of the vaccine production costs, willingness of farmers to vaccinate and to pay for vaccination of their animals were carried out by two female Malian veterinarian post-graduates in collaboration with Ecole Inter-Etats des Sciences et Medicine Veterinaires. Results indicated that the cost of producing a dose of vaccine was estimated at FCFA 157 for the LCV Xerovac, FCFA 157 for the LCV Classic and FCFA 163 for the ILRI protocol. Although the ILRI vaccine was slightly more expensive to produce, it was reported by vaccine experts that the texture of the Xerovac vaccine was less preferred by farmers (personal communication). The field deployment costs of the new vaccines will be assessed in coming weeks to complete this analysis.

Willingness to vaccinate and to pay for vaccines

A sample of 300 livestock producers was surveyed to document factors that affect their participation in vaccination. Results indicated that producers are highly willing to participate in vaccination, contrary to the perception of veterinarians. However, the main reasons why producers fail to vaccinate their animals are: self-medication (39.1%), recall of a deterrent event such as death of an animal following vaccination (14.8%), remoteness and lack of vaccination centre (12.5%), lack of information about vaccination calendars (8.2%), poor service given by an animal health worker (5.9%), and the high cost of vaccination (5.3%). The willingness to pay for vaccination (WTP) was high and ranged between FCFA 150 and 300 per dose for more than 80% of producers regardless of the proposed attribute (distance or quality of the vaccine). WTP was

highest for Mopti livestock producers. In light of the results of this analysis, recommendations to improve vaccination of livestock are: capacity building of veterinary services and their agents in charge of vaccination and better involvement and education of farmers.

Support the prevention of ruminant livestock major epidemic diseases

FTF-MLTS makes priority investments to control key killer epidemic diseases including CBPP, PPR, and bovine and ovine pasteurellosis to improve cattle, sheep and goat productivity. In Mali, livestock vaccination against the above-named diseases is mandatory, but enforcement of the policy is weak and farmers' participation in vaccination campaigns is low. In 2018, FTF-MLTS intensified activities initiated in 2017 that aimed at addressing factors that negatively affected the performance of vaccination campaigns such as limited financial and logistical capacities of private and public veterinarians, low awareness of farmers on the importance of vaccination and shortage of vaccines in the field. Participatory approaches were used with DNSV and private veterinarians to agree on the animal population targeted for vaccination in the 31 communes of the project for 2018. Prior to vaccinations, 840 messages were broadcast through local radio stations in five languages (Bamanan, Sénoufo, Minianka, Fula, Sonrhaî and Tamasheck) on the vaccination calendars and the importance of livestock vaccination. In addition, 300 posters on PPCB and PPR we produced and shared with public veterinary services in the regions. Planning and monitoring of vaccination campaigns by DNSV consisted of one mission carried out at the national level, six missions at regional level and 28 missions at local level.

Table 2. Targeted and actual numbers of animals vaccinated in 31 communes during FY18

Disease	Target No. animals to be vaccinated	Actual No. vaccinated	FY18 vaccination coverage rate (%)	Baseline vaccination coverage rate (%), DNSV, 2016
CBPP	262,930	173,756	66.1	50
Bovine pasteur.	230,260	66,780	29.0	-
Ovine pasteur.	143,240	29,288	20.4	10
PPR	203,015	153,675	75.7	7

No.=number; pasteur.=pasteurellosis

There is evidence of a significant improvement of the performance of the livestock vaccination campaign in project target communes which is illustrated by the increased number of small ruminants vaccinated. Significant improvements in vaccination coverage against baseline value for all target diseases are indicated in Table 2. Furthermore, Seydou Dara, Senior veterinary officer at DNSV stated: '*The performances of the vaccination campaigns in the FTF-MLTS program target communes coverages are the best across the country.*'

It is worth noting the significant achievements that have been made in terms of sheep and goat vaccinations (Tables 2 and 3). These efforts need to be sustained for a long period and scaled up in areas where the project is not intervening if PPR is to be eradicated. According to DNSV, this is the first time vaccination of sheep and goats against PPR reached 75% execution rate in a given area in Mali. These achievements were made possible with activities carried out by COVEM following a contract signed with the project in 2017. The participation of COVEM and their members (Table 4) in the IPs made it possible to stimulate the involvement of actors in the planning of vaccination campaigns.

Table 3. Evolution in the number of sheep and goats presented for vaccination against PPR during FY17 and FY18 in project areas covered by COVEM

Intervention zone	FY17	FY18	Change
Koutiala	900	13,700	12,800
Kléla	1,100	2,243	1,143
Sikasso	2,623	7,822	5,199
Farakala	1,000	2,031	1,031
Djénné	828	389	-439
Total	6,451	26,185	19,734

Table 4. Evolution in the number of cattle presented for vaccination against CBPP during FY17 and FY18 in project areas coved by COVEM

Intervention z	FY17	FY18	Change
Koutiala	21,300	33,700	12,400
Sikasso	10,060	14,195	4,135
Natien	2,180	4,204	2,024
Farakala	3,676	3,966	290
Djénné	5,525	7,573	2,048
Total	42,741	63,638	20,897

Higher regard of private veterinarians by farmers and increased trust between producers and 'mandataires' were noted. Major difficulties encountered by DNSV during implementation of vaccination campaigns included the security situation in areas of Mopti and Timbuktu. According to DNSV, the IPs played a crucial role in the planning, monitoring and evaluation of the vaccination campaigns with the adherence of livestock producers. Continued support of IPs is recommended. Although coverage is significantly increasing in target communes of the projects, the level is still below targets for all diseases. Intensification of efforts is recommended in 2019 and subsequent years.

Facilitate the formation and operation of community IPs

IPs played a critical role in the project implementation strategy. The overall objective of the PIs was to serve as a consultation mechanism among target value chain actors to facilitate the upscaling of technologies. During the project implementation, IPs were instrumental in planning vaccination campaigns, disseminating forage and fodder varieties among producers, supporting cross-border fairs and diversifying sources of income for women through the fabrication of feed blocks.

Fifteen IPs organized 75 meetings of members or IP committees during FY18. During the meetings, IP members discussed issues and strategies that addressed specific constraints or opportunities. IPs took the lead in adopting and implementing participatory approaches in the planning and coordination of vaccination campaigns. They were used as a means for improved the estimates of the population of animals to be vaccinated to help private veterinarians better place accurate orders of vaccines. According to COVEM, IPs played a critical role in helping to increase of number of farmers willing to vaccinate their livestock. IPs

were instrumental in building trust between producers and private veterinarians and strengthened their relationships. This situation has significantly boosted vaccination coverage especially in areas where PIs are very active. For example, in the Commune of Sincina, 1,105 cattle were vaccinated during the first day of the official launching of the vaccination campaign. According to private veterinarians, this scale was reached during previous years after only 21 days of vaccination. In Djenne commune, 650 cattle were vaccinated in the first day of the launch corresponding to four to seven days of work previously. Overall, IPs (1) improved linkages among livestock value chain actors, (2) improved knowledge of communities about the benefit of vaccination, (3) reinforced relationships and trust between producers, veterinarians and government authorities, and (4) improved accuracy of estimation of animal population to be vaccinated for better planning to avoid vaccine shortage and increased participation of farmers to vaccination, especially women. This translated to an increase of vaccination execution rates for cattle and small ruminants against CBPP and PPR by 8% and 10%, respectively, compared to previous years. Participatory planning of immunization campaigns is an appropriate tool to meet the challenge of low rates of ruminant livestock immunization and to better enhance the health mandate.

Training activities were carried out by the project experts to train IP members in leadership and facilitation. A diagnostic survey was conducted by the project within 14 IPs to identify their weaknesses and options for their improvement. Three major challenges were highlighted: the limited capacity for IP members to raise financial resources to ensure their sustainability, the absence of leadership and facilitation skills of the members, and the lack of legal recognition of the PIs. Recommendations were given to better support IPs to play their roles and ensure sustainability after the end of the project: (1) intensify capacity building efforts and coaching of IP leaders to obtsin buy in of the approach by members, (2) equip the IPs with their own financial means and (3) accelerate the process of official recognition of IPs while ensuring that this status excludes political activity.

Improving producers and CAHWs technical knowledge and skills to facilitate the uptake of selected animal health measures

Training of trainers and training of farmers on livestock disease management and food safety

Capacity building of CAHWs and producers is key to improve the quality of veterinary services to producers. Therefore, the project invested in training CAHWs and veterinary service staff who subsequently trained producers on disease control, food safety and best practices of livestock management and animal health. In Timbuktu, 50 relay pastoralists from the communes of Alafia, Douékiré, Soboundou and Soumpi were trained by the Regional Directorate of Veterinary Services on epidemio-surveillance of major animal diseases such as CBPP, PPR, pasteurellosis, Foot and Mouth Disease FMD and black leg. In the 12 target communes, 12 champion producers per village (including four women) received refresher training by ILRI experts in various topics including animal health and fattening. This was accomplished together with agents of the veterinary services, partner NGOs and the technical veterinary service . Formal training of farmers on animal health and food safety were carried out under the integrated technological package concept. In total, 2,697 (including 554 women) producers were trained in various topics of animal health and food safety.

Furthermore, short training sessions through awareness raising campaigns were conducted especially on vaccination and disease control. Ninety-two groups of farmers were educated on the importance of vaccination against PPR, PPCB, and bovine and ovine pasteurellosis in areas of AMMED; 1,855 producers in CRS and 2,055 producers in SNV areas also received the same training. Four awareness spots on the importance of vaccination were produced and broadcast on six radio stations in areas of AMMED.

Objective 2. Increase the availability of quality feed biomass, improve feed utilization and husbandry practices and promote development feed and fodder value chains

Facilitate introduction and the upscaling of improved dual-purpose crop varieties and forage species

A main objective of FTF-MLTS is to increase the availability of quality biomass to support animal production with environmental benefits. The main activities during FY18 focused on expanding activities to new villages, the selection of voluntary producers of forage, the training of farmer-trainers and producers on the techniques of production and conservation of fodder/forage, and the development of seed systems.

Identification of and education/raising awareness among participating communities and producers of FTF-MLTS

Implementing partners (CRS, AMEDD, SNV and AVSF/NGOs) held consultation meetings with communities in their respective target communes to consolidate participation of former beneficiaries of the project and to identify new ones. At the beginning of the campaign, implementing partners organized information and awareness raising meetings to share the results of the last campaign in order to draw necessary lessons to better organize and plan future interventions and to increase not only the number of beneficiary producers but also the surface area planted with fodder/forage species. Thus, according to a bottom-up planning diagram of meetings, 183 village meetings (AMEDD: 92, SNV: 48 and CRS: 43) were organized at the base. This allowed community leaders and IPs to continue discussions and make useful decisions on ways to implement activities, 12 of which were organized by AMEDD, six by SNV, four by CRS and five by AVSF. Overall, these activities mobilized nearly 11,000 livestock producers in the project area, including 3,300 women.

Extension of the project intervention area and increase in the number of beneficiaries

Out of the 36 new villages identified in the project area, three were covered by AMEDD, 12 by SNV and 21 by CRS. In the new selected communities, 3,536 new beneficiaries were identified, including 1,380 under supervision of AMEDD, 720 under SNV and 1,436 under CRS. The partner NGOs went through two) complementary approaches to identify new beneficiaries. Indeed, depending on opportunities, choices were made in former villages where the potential to recruit new beneficiaries was favourable or in new communes such as Madiama, Djénné/Mopti in the area covered by CRS. Due to restricted movements of support services in relation to the volatile security situation, specifically in the Mopti Region, CRS, to extend its area of intervention, had to select an additional commune in the district of Djenne, i.e. Madiama. SNV opted to densify its area by selecting 12 new villages in its old target communes to increase to 48 the number of villages covered, including 36 former communes. New villages covered by SNV are: Kouoro, Ifola, M'Pèdougou, Nontanso, Kalifabougou, Gniriwani, Oussélékè Diassa, N'Tibougou, Kourvédougou, Giéworodougou in the 'Circle' of Sikasso, Yentéla and Djiguinè in the district of Djenne (Mopti).

Training and demonstrations on fodder and forage production

AMEDD**:** 102 trainers including six agents of AMEDD, four trainees and 92 farmer leaders were trained to train in return producers. Farmers Field Schools totaling 46 ha have been set up in the 92 villages. In 2018, 56 producers per village (92 villages), i.e. 5,152 producers (out of which 1,649 were women) were identified, trained and supported for fodder and forage crops production.

SNV: Training of farmer-trainers was conducted in May and June 2018, respectively in Gongasso and Farakala. The two sessions were moderated by the GEFAD program officer, and 68 farmer-trainers were trained on the techniques of production and conservation of fodder and seeds. In Djenne, twenty-eight farmer-trainers became familiar with the techniques of production and conservation of Sangaraka cowpea and sweet sorghum Seguifa, to better replicate the concepts learned to the benefit of producers in their respective villages. Training of producers on fodder/forage and seed production techniques was carried out in June and July 2018 in the municipalities of Gongasso, Farakala, Natien and Kouoro, Djenne. A total of 908 farmers received training during that period.

CRS: Agro-pastoralists were trained to become trainers on forage production of dual-purpose fodder crops during two intensive training sessions. Each of the sessions lasted two days per site. A first session, conducted in Fakala, Sio and Socoura, focused on themes related to techniques of harvesting, drying, storage, preservation of fodder and grains (sorghum, cowpea and groundnut), and on estimating grain yield and biomass. A total of 84 men and 48 women participated. The second session held in Socoura, Fakala, Madiama and Sio focused on constraints to livestock production, the production techniques of food feed crops (appropriate seeds and establishing contacts between seed producers, seed treatment, seed spacing, calendar/timing of agricultural activities, applying compost or mineral fertilizers etc.); the principle of farmers field schools facilitation (FFS) with the participation of 127 men and 47 women. Subsequent to the training, the following practical advice was given to participants: 1) active participation in demonstration sessions in the FFS and 2) compliance with techniques and technologies on the extension plots of farmers groups (as well as FFS as on their own plots) in the agricultural calendar (even when the extension agent is absent). In total 3,144 agro-pastoralists including 947 women (30%) participated in feedback sessions on production techniques of dual-purpose fodder crops in 43 villages, 1,382 of them (446 women) were new beneficiaries.

Farmers Field Schools

To contribute to the sustainability of the project achievements, the main criteria on which NGOs have relied on for the establishment of the field schools include: ease of access to the plot and the degree of adherence to the standards of the project, openness of mind and commitment for the application of innovations and the level of equipment of the agro-pastoralist for the implementation of advocated technical guidelines on the plot. In the project area, 226 field schools, in total, have been set up, 92, 48 and 86 under AMEDD, SNV and CRS, respectively. Thus, IPs, networks of farmer-trainers and focal points identified in villages supervised through the support of partner organizations (NGOs, state technical services and the private sector) have contributed in setting many plots for extension purposes. Table 5 provides surface areas planted with various crops.

Table 5. Surface areas planted in the project zone (ha)

	Dual-purpose forage varieties			Forage species			
NGOs	Cowpea	Sorghum	Groundnut	*Brachiaria*	Mucuna	Bourgou	Total
AMEDD	710	775	6	303	182		1,976
SNV	252.62	190.75	3.5	54.9	56.5		558.3
CRS	58.98	90.52	11			140	300.5
AVSF						269.5	269.5
Total	1,021.6	1,056.27	20.5	357.87	238.5	409.5	3,104.2

Production, procurement and distribution of fodder and forage seeds

To prepare agro-pastoralists to a zero-subsidy seed system and to ensure IPs are taking steps to sustain fodder and forage crops productions, the project has reduced the seed grant provided to agro- pastoralists in a gradual process of concluding the free provision of seeds by the end of year three of the project. In total, the project has provided 210 kg of seeds of *Brachiaria ruziziensis* and 1,000 kg of *Mucuna* seeds to partner NGOs. These seeds were distributed as follows:

- *Brachiaria ruziziensis*: 160 kg to AMEDD and 50 kg to SNV
- *Mucuna*: 650 kg to AMEDD and 350 kg to SNV.

Seed distribution through the 'revolving system' was initiated from year one. It is seen as an endogenous mechanism of seed distribution among agro-pastoralists within the IPs and the system is now a well-accepted practice. The mechanism has permitted recovering the volume of seed initially placed at agro-pastoralist levels by seed producers through the IPs, and gaining an extra quantity of seed considered as interest on the original investment. The rate of seed return which is applied varies with respect to communes and specific crops. For the target communes the following rates are applied: 150% for *Brachiaria* and 200% for sorghum, cowpea and 'Bourgou'. The momentum generated helped set in motion an important seed stock for crops promoted by FTF-MLTS. Overall, the process has helped mobilize about 15,657 kg of seeds in the project area (Table 6). Regarding future prospects, the main challenge is to take appropriate measures to harmonize approaches in order to structure the mechanisms, based on standards, to integrate the 'revolving' approach in the global process of supplying agro-pastoralists with good-quality seeds. Table 6 presents an overview of seed stocks generated through the seed revolving system.

Table 6. Seed stocks mobilized through the seed revolving system (kg)

NGOs	Forage varieties				Total
	Sorghum	Cowpea	*Brachiaria*	Groundnut	
AMEDD	6,072	6,072	53	-	12,197
SNV	388	272	50	40	750
CRS	1,260	622	-	828	2,710
Total	7,720	6,966	103	868	15,657

Evaluation of quantities of biomass produced

To help agro-pastoralists cope with recurrent dry season feed shortages of livestock, the project has undertaken the dissemination of fodder and forage crops in target communes. Thus, agro-pastoralists have cheap feed resources on hand to support the different animal production sectors during periods of seasonal feed deficit. During the three years of project intervention, significant progress has been made. Table 7 shows estimates of livestock feed production during FY18.

Table 7. Estimated biomass production in the project area

ONGs	Dual-purpose fodder crops						Forage crops					
	Cowpea		Sorghum		Groundnut		*Brachiaria*		Bourgou		Mucuna	
	Sup. (ha)	Biom. (t)	Sup. (ha)	Biom. (t)	Sup. (ha)	Biom. (t)	Sup. (ha)	Biom. (t)	Sup. (ha)	Biom. (t)	Sup. (ha)	Biom. (t)
AMEDD	342	582	696	1,916	6	10	299	4.487			182	910
SNV	253	430	191	526	44	6	55	823			57	28
CRS	64	109	77	213	16	28			140	602		
AVSF									378	1.725		
Total	659	1,121	964	2,655	25	44	354	5.310	518	2.227	239	1,193

Sup.: Area; Biom.=Biomass; ha= hectare; t: tonne

The overall quantity of biomass produced from all fodder/forage varieties grown in the project area is estimated at around 12,500 t of dry matter in FY18. This is important extra feed which helps support livestock keepers during the dry season. A total of 28,000 cattle could secure their dry matter requirements for three months during the dry season with this amount of feed. Moreover, thanks to rationing practices at lower cost based on integrated technology packages, disseminated by the project through training modules, agro-pastoralists are able to enhance the value of the feedstuff produced by combining it with other on-farm feed resources. Specific biomass and grain yields achieved in various target communes are indicated in Tables 8 and 9.

Table 8. Estimates of forage production in SNV communes

Forage type	Area (ha)	Biomass estimate (t)
Cowpea	252.6	378.4
Sorghum	190.8	2,378.1
Peanut	3.5	3.5
Brachiaria	54.9	823.1
Mucuna	56.5	85.1

ha=hectare ; t=tonne

Table 9. Average yield per variety (2017/18 agricultural campaign) in communes covered by CRS

Crop	Variety	Source of seed	Types of products	Average yield/ha
Sorghum	CSM63E / Jacumbe	IER	Grain (kg)	824
			Biomass (kg)	2,755
	Enba Dendi	Producers supervised by USC Canada	Grain (kg)	908
			Biomass (kg)	2,605
	Enba grenoue		Grain (kg)	900
			Biomass (kg)	2,600
Cowpea	Korobalen	IER	Grain (kg)	1,080
			Biomass (kg)	1,518
	Wilibali		Grain (kg)	743
			Biomass (kg)	1,029
	Sankaraka		Grain (kg)	450
			Biomass (kg)	1,674
Groundnut	ICGB	ICRISAT	Grain (kg)	196
			Biomass (kg)	804
	Flower 11		Grain (kg)	433
			Biomass (kg)	1,761

ha=hectare; kg=kilogram

As for the cowpea biomass production, Sangaranka and Korobalen varieties were preferred by farmers over Wilibali. Sangaraka ranks first, followed by Korobalen, then by Wilibali. However, for the production of grain, Korobalen and Wilibali varieties were the most successful; Sangaranka barely produced seeds. Thus, Korobalen and Sangaraka varieties respond better to the features of dual-use crops in the project area. As for Sankaranka, the agro-climatic conditions do not provide enough opportunity for this variety to show its potential/performance in seed production.

The three varieties of sorghum (CSM63E/Jacumbe, Emba Dendi and Emba Grenoue) were all well-appreciated by the recipient producers. Specifically, the CSM63E or 'Jacumbe' was preferred by farmers because of its high production of seeds and its significant forage potential. The varieties Emba Dendi and Emba Grenoue (local variety originating from 'Circle' Douentza/Mopti), were also well- appreciated because of their high capacity of resistance to water stress and to strong winds compared to the CSM63-E. However, they produce more forage when compared to the CSM63-E but less seeds.

Two groundnut varieties were pilot tested in the fields of women's groups. These are Flower11 and ICGB, both received from the ICRISAT Groundnut project. Flower11 was preferred, both for its forage as well as its seed production compared to ICGB. The latter has been very sensitive to insect attacks. Overall, the two varieties showed a low-germination rate because of the drought pocket observed during their sowing period.

Bourgou production

To be eligible for support, 'Bourgou plots' management committees must organize into a cooperative society according to the Organisation for the Harmonization of Corporate Law in Africa (OHADA) Act. Thus, a working session was conducted with each of the 'Bourgou production groups' management committees on the techniques to prepare the statutes and bylaws of a cooperative society. At the end of the session, a draft of the statutes and bylaws were developed by the management committee of Dio. Moreover, the application of draft internal rules about the livestock movements around Bourgou production plots in Socoura, Fakala and Sio allowed committees to generate cash totaling FCFA 868,750. This amount was used to rent farm equipment to plough a Bourgou plot, to ensure security of the plot, to pay for OHADA matriculation, to purchase farm equipment (plough, sickles) and to give loans to group members for livestock fattening (Table 10).

Table 10. Income generated through Bourgou production and its allocation to various uses

Commune	Production site	Total income (FCFA)	Monitoring the use of income (FCFA)	
			Nature of expenditures	Total amount
Socoura	Nantaka	312,750	Costs for ploughing and security/monitoring the plot, fee for obtaining OHADA receipt	158,000
Sio	Dio	342,000	Costs for ploughing and securing the plot, fee for obtaining OHADA receipt, purchase of two ploughs and sickles	200,000
Fakala	Guidiowel	214,000	Costs for ploughing and security/ monitoring the plot Fattening loans to three women, FCFA 60,000 per woman	210,000
TOTAL		868,750		564,000

FCFA=CFA franc ; OHADA= ;

Promote the upscaling of integrated packages for improved cattle, sheep and goat productivity

Integrated packages are bundles of animal health and feed technologies combined with best husbandry practices designed to support cattle and sheep intensified-production models that improve productivity and profitability of livestock enterprises. They are tailored to specific production objectives including cattle and sheep fattening, dry season strategic supplementation of lactating cows and better management of cattle used for draught animals. Integrated packages build on FTF-MLTS interventions that promoted better animal health and increase in the availability of quality biomass.

Identifying fatteners, monitoring operations and providing advice

In the project area covered by SNV in Sikasso and Djenne, 600 producers, distributed into 25 groups by theme (fattening, milking/lactating cows, maintenance of oxen and small ruminants) have been identified and validated by the IPs. During FY18, 600 sheep and 1,009 cattle were fattened and sold. In the 12 target communes covered by AMEDD in the districts of Sikasso and Koutiala, 1,096 producers fattened 1,114 cattle and 3,009 sheep with the sheep mainly fattened by women. In Mopti, CRS listed a total of 701 fatteners who have been sensitized to the benefits

associated with adopting integrated packages. Table 11 shows the number of fatteners per sex and the number of cattle and sheep fattened that they have produced during the year in the target communes of Socoura, Sio and Fakala.

Table 11. Fatteners identified in the target communes of Socoura, Sio and Fakala

Communes	No. sheep fatteners			No. sheep fattened	No. cattle fatteners			No. cattle fattened
	Male	Female	Total		Male	Female	Total	
Socoura	91	39	130	650	69	14	83	498
Sio	87	24	111	555	50	8	58	378
Fakala	136	48	184	920	97	38	135	810
Total	314	111	425	2,125	216	60	276	1,686

Strengthening the capacity of fatteners

The training of producers who have adopted the integrated packages was conducted in two phases: the first theoretical phase is based on sharing of producers' experience as a basis for a participatory analysis of strengths and weaknesses of their practices and factors that determine success and profitability of fattening operations. Advice was provided on the important elements to take into account to increase the profitability of their fattening business. Decision-making regarding the age and sex of an animal bought for fattening, feeding and watering practices, the timing of the operation and the time to buy and sell animals are typical factors that influence the performance of fattening enterprises. The practical phase of the training was based on the analysis of financial and economic elements of a fattening workshop to estimate the cost streams and benefits, and therefore the profitability of the operation. Training sessions were completed with sanitary advice regarding medication use, the importance of de-worming and immunizations, and treatment in case of signs of diseases. In the CRS area, 248 fatteners including 56 women (23%) participated in training sessions on fattening techniques. In the AMEDD area, in Sikasso, 1,096 fatteners including 383 women (i.e. 32%) were trained and supported in 92 villages on the integrated package modules. In the Timbuktu area, 300 producers in the target communes of Timbuktu, Alafia, Douékiré, Soboundou and Soumpi were identified and trained. The training was conducted in 10 sessions on the management of cattle and sheep fattening units using materials on integrated packages. Among these trained farmers, 165 producers have fattened 108 cattle and 809 sheep.

Developing capacity of producers on feed processing and promoting the establishment or consolidation of private small-scale feed manufacturers

Strengthen the capacity of women's groups on the use of grinders to produce feed

In the Sikasso Region, the cooperative of N'Goutjina benefited from a grinder for the production and marketing of nutritional densified blocks as livestock feed. Forty-two producers from five communes (N'Goutjina, Sincina, Kapala, Zangasso and Kolonigué) were trained on ways to produce densified livestock feed blocks. They produced 2,104 kg of food intended for animal fattening. The Zangasso cooperative produced 1,560 blocks of 3 kg each that were sold at FCFA 1.56 million; 3,741 women were rotationally trained in the villages of the three communes.

In the Timbuktu Region, 25 women of the SOUBA NAFA women's association were trained in Niafunké ('Commune' of Soboundou) on the production and marketing of nutritional blocks.

During the production campaign, nine sessions were conducted by the association with a total production of 337 units/blocks sold at FCFA 337,000 and a net profit of FCFA 147,000.

The members (24 women and one young male) of the IP of Kouoro received training on production and marketing of nutritional blocks in March 2018 in Kouoro for income generation purposes. They set up a management committee as follows: a female president, female treasurer, a woman in charge of production, a female responsible for marketing and a female responsible for organization. Key activities carried out included the monitoring livestock feed mill units and training of members of the Kouoro IP on the production and marketing of nutrient blocks. The monitoring of the livestock feed mill unit at Kouoro indicates that women were able to make a net benefit of FCFA 1.5 million (Table 12).

Table 12. Performance of the Kouoro women's group in nutrient block production

Product	Quantity	Income (FCFA)	Charges (FCFA)	Benefit (FCFA)
Farakala feed mill unit				
Nutritional blocks	2,400 blocks	2,031,850	1,068,490	1,117,740
Densified blocks	5,146 t	154,380		
Kouoro feed mill unit				
Multi-nutritional blocks	146 blocks	92,350	52,410	39,940
Djenne feed mill unit				
Multi-nutritional blocks	12,38 blocks	465,000	1,789,735	374,265
Densified straw bags	523 bags	1,569,000		
Densified blocks (kg)	325 blocks	130,000		

FCFA=CFA franc ; kg=kilogram; t=tonnes

Exchange visit. An exchange visit for the introduction of the feed grinders between producers of Timbuktu and those of Koutiala was organized. The participants to the visit were five presidents or representatives of IPs, two female representatives for the production unit of nutritional blocks and two agricultural machinery mechanics from Timbuktu. During the visit that took place in the N'goutchina, the management committee presented the operating strategy of the feed grinder. Thereafter, demonstration sessions were performed on grinding millet stalks, rice straw, bush straw and pods of Gao (*Acacia albida*). The operation continued with mixing the different ingredients obtained from grinding to produce densified nutritional blocks. The sessions were concluded by the preparation of the premix solution (1 kg of urea + 0.1 kg of Tilemsi natural phosphate + 1 kg of salt dissolved in 2 litres of hot water mixed with 3 kg of molasses). This solution is used on 25 kg of straw which is then well mixed/kneaded and exposed to open air under shade for drying.

Objective 3. To leverage USAID-led livestock market development and policy initiatives in support the upscaling of ruminant livestock productivity enhancing technologies

Revitalize LMIS to capture market incentives

Upgrade LMIS

LMIS Version 4 software was updated to improve some of the data transfer functions and accommodate administrative oversight, and an alpha version of a buy/sell module was added to the system. Improvements to the data transfer functions included error trapping for users entering incorrect dates, evaluating data as it arrives via SMS and catching errors with incorrect codes or spacing, and providing market monitors with SMS feedback on the type of error. Modifications were also made to the LMIS website front page to show prices that have been collected during the last 14 days and show 'no report' for active markets that have not reported data during the last 14 days. Improvements were also made to reporting of data anomalies to system administrators, so that data anomalies can be easily checked on a daily basis to ensure that prices or volumes that greatly exceed long term average values can be checked and evaluated. For the alpha version of the buy/sell capabilities, a module was developed that allows web users to enter information into the website on animals that they would like to buy or sell. The user can add the information by registering their phone number on the website, and then filling out a form that will indicate whether they are buying or selling, the kind, breed, age, sex and grade of the animals they want to buy or sell, their location, and their asking or selling price and volume. The module has currently been made available to OMA for testing, and feedback gathered on improvements/changes.

During February 2018, Texas A&M AgriLife Research installed an evaluation version of the LMIS 4 software on OMA's server and added improvements to the server for backing up data in a cloud database. Training was also provided to local stakeholders including OMA staff and DNPIA personnel on the LMIS Version 4 software. Training was also provided to OMA on server administration and database maintenance for the new version.

In September 2018, the latest version of the LMIS Version 4 software was installed on the OMA server that included changes based on OMA's feedback. The transition was made from Version 3 to Version 4 of the software and Version 4 went live and can be accessed via http://www.malibetail.net. The system administrative components can be accessed at http://www.malibetail.net/lmis_admin. The administrative component allows OMA to add users, markets and evaluate data anomalies. It is password protected to only allow administrators to evaluate and correct data.

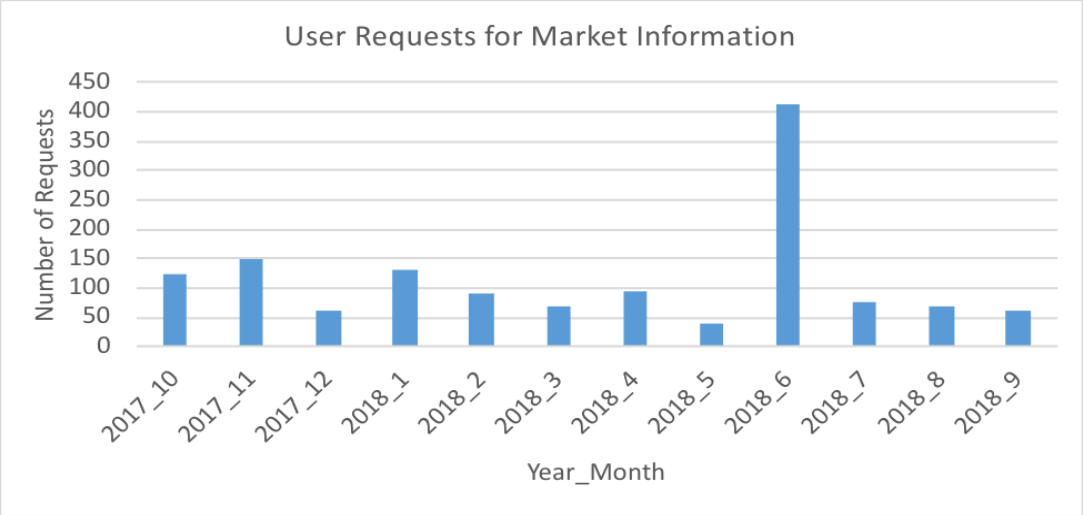
An Installation Guide and System Administration manual for the LMIS Version 4 software has been completed provided to OMA for evaluation and feedback. The Installation Guide provides system administrators with step-by-step information on how to install the LMIS software and SMS modem. The System Administration Manual provides administrators with information on adding users, markets, and products, detecting and fixing data anomalies, and for correction of price and volume data that may have been entered incorrectly.

Livestock information system use and analytics

During FY18, LMIS use was evaluated using server logs of messages received and through Google Analytics. With regard to messages received by the server where users made a request for market information via SMS, the average number of requests per month was 114 for the fiscal year.

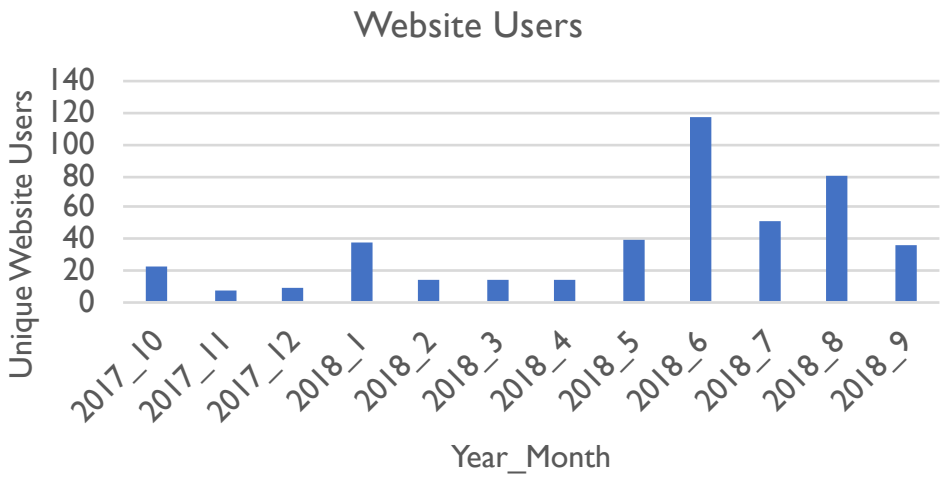
However, the number of requests varied each month with the lowest number of requests in May 2018 (39 requests) and highest in June 2018 (414 requests, Figure 5).

Figure 5. Number of requests made by users for market information via SMS message.



For the LMIS website, analytic information gathered indicates that, on average, 39 unique users accessed the website each month. Like SMS requests, the use was variable across the fiscal year with the lowest website use in November 2017 (seven users) and highest in June 2018 (117 users) (Figure 6). Return users to the website averages 7%. Analytics on the use of the website by country indicated the most use from France (62%), followed by the US (12%) and Mali (9%). On average, website users spent almost two minutes on each page viewed.

Figure 6. LMIS website users.



Improve LMIS operations

Capacity building and collection and transfer of livestock market data: With the resumption of data collection and availability of data on the server, the training of livestock production and marketing actors to enable them to use the information system became necessary. This system has been designed and implemented to allow livestock value chain actors to access reliable and timely market information that guide their marketing decisions.

Dissemination of livestock market information through different radio stations is ongoing. Market enumerators and radios directors and broadcasters are working together to disseminate livestock market information throughout rural radio stations every week. During this period, one of our signature achievements was the training of 22 radio presenters so that they can better understand the system and accurately disseminate livestock market information to the population. The radio presenters were enthusiastic and willing to improve the system by making every effort to regularly provide actors (pastoralists and agro-pastoralists, traders, policy-makers and other users) with reliable information to enable them to make better decisions on livestock marketing.

The FTF-MLTS program set out to revitalize the Mali LMIS that was set up by previous USAID projects and seek ways to make the system more sustainable following the identification of gaps. OMA and DNPIA was responsible for the implementation of this activity.

The collection and transmission of data from 17 target livestock markets was carried out by enumerators on a daily (4) or weekly (13) basis depending on the frequency of the market. Information on average animal prices by species, breed, category, gender and conformation is available and accessible from cell phones and on the website www.malibetail.net. The requests on the server from the cell phones of the majority of applicants have increased especially with the start of the activities of the PRAPS project. Since January 2018, 35 additional livestock markets have been monitored by the PRAPS project.

For the livestock markets of the Mopti Region, new security measures taken by the authorities of the region prohibited the circulation of motorbikes and pick-up trucks. This situation had a slight impact on the influx of livestock markets.

Pastoralists and agro-pastoralists have begun to realize the benefits derived from some activities organized by partners in the livestock sector, in particular, sales operations for Ramadan and Tabaski. During the reporting period, 960,251 head of cattle were presented on all 17 markets except Kouoro Barrage; 600,293 heads of cattle were sold, for a sales rate of 63%. Concerning sheep, 983,934 heads were presented on the monitored markets while 527,901 heads were sold, giving a sales rate of 54%. Regarding goats, 855,589 heads were presented on the monitored markets; 542,720 heads were sold with a sales rate of 63%.

Facilitating the development of competitive cattle and sheep production and marketing models

One objective of FTF-MLTS is to support the competitiveness of family-based cattle and sheep fattening enterprises to improve their further penetration in domestic and export livestock markets. Sustaining these fattening operations requires: (1) access to financial services to enable fatteners to have access to high payoff inputs such as feeds and finance their trade operations, (2) facilitate market access and reduce trade volatilities through contracting that links buyers to markets through agreement, (3) access to feeds, veterinary inputs and services and (4) improve fatteners' decision-making processes with regard to calendar of production and marketing, price discovery, risk management and training to develop managerial and technical skills. Activities conducted in FY18 focused mainly on developing links between fatteners and financial institutions, on facilitating commercial relations between fatteners and buyers, including Laham, and facilitating promotional sales of small ruminants during the Tabaski celebration.

Linking fatteners with financial institutions

FTF-MLTS and FFSWE worked together to facilitate access by ruminant livestock value chain actors to financial institutions to apply for credit needed to finance their operations. Main value chains actors interested in credit were essentially cattle and sheep fatteners, private veterinarians and women's groups running small-scale livestock feed processing units. Key actions taken to facilitate access to credit included identification of volunteer actors, strengthening managerial skills, developing business plans and helping farmers to file and submit loan applications.

Mr Fatié Sanogo from Farakala was seen as a model farmer to raise awareness among farmers about the existing credit opportunities and ways to take advantage of them. To set the link between fatteners of Kouoro 'Barrage' and MicroCred, a first meeting took place in November 2017, with the participation of 16 fatteners. After a detailed description of the conditions for loans by the representative of MicroCred, fatteners committed and those who satisfyed conditions to run the operation were invited to open bank accounts at the agency. They requested a loan totaling FCFA 40.5 million. The files were submitted to MicroCred for a feasibility study and to BoA, Koutiala, for funding. In Farakala, the link-up meeting was held in December 2017. Subsequently, 20 business plans were developed and eight fatteners obtained loans totaling FCFA 10 million from Kafo Djiguine. Mr Sanogo obtained his fourth round of financing. The link-up with Natien fatteners was held in December 2017, in Natien, with 28 participants.

After a meeting between Djenne and Femaye IPs, fatteners and the credit facilitator of the Mopti Region in December 2017, , six loan files were developed and two deposited at financial institutions. The cooperative 'Pinal' has opened an account and the other cooperatives and individual fatteners are invited to do the same with Fantaw Djiguifaso, another microfinance structure. The prevailing insecurity in the Mopti Region makes microfinance agencies reluctant and slows down the processing of loan applications. Since 2017, 44 applications for loans were submitted for financing in favour of agro-breeder organizations and individuals. To date, all application files have been transmitted to Toguna Consult. Out of these 44 applications, 10 have been submitted to microfinance institutions (PAMF) and to BNDA (National Bank for Agricultural Development). However, beneficiaries of these loans are not yet in possession of the money requested. The remaining 34 application files are still not transmitted to the funding agencies, due to slowness in the processing of these files.

Overall, a total of 34 livestock-based loan applications with an amount of FCFA 128.2 million (USD 223,204, Table 13) were processed by financial institutions (BIM, BoA, microfinance organizations: Kafo Jiginew, MicroCred and PAMF). Twelve applications (FCFA 17.7 million, USD 32,034) were so far approved. It is worth noting that microfinance institutions are more flexible than banks to provide loans to livestock value chain actors. None of the loan applications to BoA or BIM by livestock farmers was approved. Only one application for loans by private veterinarians (Sikasso and Farakala 'agents') has been approved by BoA.

Table 13. Status of livestock-based loan applications

Name of entity	If financial institution is non-DCA, specify	Value of loan submission (1,000 FCFA)	Value of loan submission USD	Value of loan approved (1,000 FCFA)	Value of loan approved USD	Business location
Cooperative agropastorale de Farakala	Kafo Jiginew	1,500	2,803	750	1,365	Sikasso
Chaka Sanogo	Kafo Jiginew	1,500	2,803	1,000	1,880	Sikasso
Fadougou Koloma	BoA	8,000	15,094	-	-	Sikasso
Cooperative Agro-pastorale (Fatie Sanogo)	MicroCred	2,652	4,421	2,652.5	4,421	Sikasso
Cooperative Agro-pastorale (Fatie Sanogo)	Microcred	3,000	5,000	3,000	5,173	Sikasso
Groupement N Gowaton	Kafo Jiginew	900	1,682	900	1,692	Sikasso
Moussa Dembele	BoA	10,000	18,867	-	-	Sikasso
Aboudou Sanogo	MicroCred	1,500	203	-	-	Sikasso
Adama Dembele	BoA	10,000	18,867	-	-	Sikasso
Bourama Dembele	BoA	8,000	5,660	-	-	Sikasso
Zoumana Kone	BoA	3,000	5,660	-	-	Sikasso
Issa Traore	Kafo Jiginew	600	1,121	600	1,128	Sikasso
Amadou Diallo	Kafo Jiginew	1,500	2,803	1,000	1,810	Sikasso
Chaka Coulibaly	Kafo Jiginew	500	934	500	940	Sikasso
Lassina Coulibaly	MicroCred	600	1,121	-	-	Sikasso
Mariam Sanogo	MicroCred	500	934	-	-	Sikasso
Youssouf Cisse	MicroCred	1,100	2,056	-	-	Sikasso
Boukary Diakite	BoA	10,000	18,867	-	-	Sikasso
Klezanga Dramane	BoA	2,500	4,717	-	-	Sikasso
Tiemoko Sounkara	BoA	1,500	2,830	-	-	Sikasso
Salihou Diallo	BoA	3,000	5,430	-	-	Sikasso
Atelier Embouche Drissa Coulibaly	BoA	3,000	5,400	-	-	Sikasso
Cooperative Agro-pastorale (Fatie Sanogo)	MicroCred	4,138	7,697	4,138	7,779	Sikasso
Lassine Sanogo	MicroCred	1,200	2,173	1,200.6	2,257	Sikasso
Siaka TRAORE SINKOLO	BoA	10,000	18,100	-	-	Sikasso
Cooperative sinignesigui Gouan	Kafo Jiginew	1,000	1870	1,000	1,880	Sikasso
Ousmane TRAORE	MicroCred	954.9	1,699.74	954.9	1,709	Sikasso
Kamian Komani	PAMF	3,257.5	5,830.93	-	-	Mopti
Societe Cooperative SAYERE SAMBA	PAMF	5,144	9,207.76	-	-	Mopti

Name of entity	If financial institution is non-DCA, specify	Value of loan submission (1,000 FCFA)	Value of loan submission USD	Value of loan approved (1,000 FCFA)	Value of loan approved USD	Business location
Nouhoum Sangha	PAMF	5,971.5	10,688.99	-	-	Mopti
Boureima Tangara	BIM	1,561.5	2,795.09	-	-	Mopti
Sory Bocoum	BNDA	3,450	6,175.50	-	-	Mopti
Cooperative KAOURAL	PAMF	428	766.12	-	-	Mopti
Djibril SIDIBE	BoA	16,250	28,925	-	-	Sikasso
TOTAL=34		128,208.5	223,204	17,696	32,034	

BIM= ; BoA=Bank of Africa, Mali; PAMF=Premiere Agence de Microfinance-First Microfinance Agency

Organizing livestock trade fairs on cross-border markets for the promotional sale of sheep for the Tobaski Feast

FTF-MLTS supports the organization of cross-border trade during Tobaski to increase livestock supply from project target communes. In partnership with the FEBEVIM, FTF- MLTS officially launched Tobaski 2018 Trade Fairs on Wednesday, 18 July 2018 at Siekorole and on 24 July in the border town of Kouremale. Both events were attended by representatives from commune authorities, FEBEVIM, the local press, cattle traders and members of their unions, officials and market agents from Guinea. The delegation of Guinea-Conakry included livestock traders' associations, custom officers, police officers, veterinarians and chamber of commerce. The events were marked by major addresses delivered by the commune leaders, FTF-MLTS, 'Sous-Prefets' and invited guests from Guinea. Prior to the events, radio programs were transmitted in the project's zone of influence (ZOI) and in the Kankan Region, Guinea, to inform all stakeholders about the opportunities of ruminant livestock trade in these two markets, two weeks before Tobaski. To encourage producers participation in the FTF-MLTS ZOI, meetings were held with the IPs to give them information on these business opportunities.

The monitoring of livestock trade transactions in the two livestock markets show that during the fair period, before Tobaski Day, a total of 5,050 small ruminants were presented on the two border-markets (Kourémalé and Siékorolé.) (Table 14). The highest rate of sales (97%) was recorded on the evening before Tobaski; the average for the period was 63% on each market day. In total, during the two weeks preceding the Tobaski celebration, 2,451 sheep and 727 goats valued, respectively, at FCFA 172,816,250 and FCFA 28,661,625 were sold and exported to Guinea.

Table 14. Number of sheep and goats presented and sold and sales rates of small ruminants at the border markets of Kourémalé and Siékorolé between 18 July and 17 August 2018

Market	Livestock species	Presented	Sold
Kourémalé	Sheep	1,745	1,543
	Goats	613	595
	S/Total 1	2,358	2,138
Siékorolé	Sheep	2,433	908
	Goats	263	132
	S/Total 2	2,692	1,040
Total of sheep on both markets		4,178	2,451
Total goats on both markets		876	727
Total small ruminants on both markets		5,050	3,178

The facilitation of commercial relations between fatteners and buyers

Laham managers payed a visit to cattle fatteners of IPs of the Sikasso Region. Previously, an inventory of the animals complying to the standards requested by the Laham society (i.e. entire males with body weight greater than or equal to 300 kg) was affected within IPs. Visitors from Laham expressed their satisfaction with regard to the quality of the animals in the six workshops visited. They were also impressed by the scale of fattening activities conducted each season in these two communes. A meeting between the Laham managers and fatteners led to the decision to send convoys of fattened animals to Kayes (Laham) to better assess the profitability of this operation. The meeting decided that the first convoy would be sent on 10 April 2018. It was also agreed that Laham would make a truck available for the transport of animals from Kouoro to Kayes. After this first test, the other IPs would deliver more animals to Laham. Unfortunately, against all expectations, after a series of postponements of convoy-test dates (10, 14, 16 and 19 April 2018), Laham cancelled the operation. Apparently, Laham was going through cash shortages that prevented it from proceeding. Fatteners who had agreed to keep their cattle for the operation were disappointed. They were, however, able to export their animals to Côte d'Ivoire and Senegal. FTF-MLTS will continue its efforts to engage with Laham so that challenges hindering the commercial linkages between Laham and fatteners can be overcome.

The study carried out by FTF-MLTS on 'Perspectives on the competitiveness of live animal versus meat exports in Mali' during FY18 revealed that the fundamental constraint in Sahelian and west African markets is a lack of product differentiation, stemming from an imbalance in demand, lack of market access and underdevelopment of market opportunities. The ability of leading beef exporters (Brazil, Argentina, Uruguay, Australia, USA) to be profitable rests in their ability to maximize the value of the carcass by selling cuts to those markets that pay the most for them. By contrast, the practice of selling beef at average value (as opposed to differentiating by cut) in west African markets and a lack of developed higher-end markets limits the power butchers and others have to price offals more competitively. One could argue that while this gives higher-end consumers 'artificially' cheap meat, this likely comes at the cost of consistent quality and food safety that more integrated supply chains would provide. The status quo also, paradoxically, raises the price of lower-value cuts for poorer consumers.

In this sense, the strategy that innovative abattoirs like Laham are pursuing is a sensible one. However, significantly more work will be needed to develop segmented markets for beef at end-consumer level alongside production and marketing strategies that can facilitate the sale of cheaper

offals to consumers. Focusing on the supply side is not sufficient—a demand-driven strategy led by buyers is key. The key informant interview with the international meat trader demonstrated a very strong interest in trading and selling meat from the Sahel to the coast, but this would necessitate market development and differentiation on the one hand with the ability to produce and sell frozen offals to a broader consumer base on the other.

Gender-related achievements and how gender is mainstreamed into activities

In general, women are involved in all project activities. In the Mopti Region, 30% of the project beneficiaries are women (961 out of 3,239 producers). Of the 1,436 new beneficiaries identified during registration in the 21 new villages, 431 were women. Women are committed and participate in the activities of the IPs, including the preparation and implementation of vaccination campaigns, the production of fodder, livestock fattening and marketing. In particular, they are very visible through in the operation of livestock feed mill units. Women members of IPs also participate in regular IP meetings. In Mopti's target communes covered by CRS, the participation of women in training and sensitization/awareness sessions on technologies and good practices for livestock is summarized as follows:

- Out of 174 agro-pastoralists who received intensive training sessions for trainers on the production of fodder, 47 were women;
- Out of the 3,144 agro-breeders who participated in intensive feedback sessions conducted by agro-breeder trainers on the production of dual-use forage crops, 947 were women;
- Out of 701 fatteners who participated in sensitization sessions on integrated packages, 171 were women; and 56 women (out of 248 participants) were trained on economic and financial aspects of fattening;
- Sensitization on 'Bourgou, *Echinochloa stagnina*' production techniques targeted 102 women out of a total number of 462 participants. In addition, 17 women out of 45 members of 'Bourgo plots' management committees received training on the development of business plans and resource mobilization.

In Sikasso and Djenne, in target communes covered by SNV, 166 women members of the feed cooperatives (Farakala 20, Kouoro 24, Djenne 52 and Femaye 70) participated in the manufacturing of multi-nutrient blocks and animal feeds from cereal-crop residues during FY18. This allowed the production and sale of 3,784 multi-nutrient blocks and 525 cattle feed bags of 25 kg each. With feed grinders, women's groups produced 5,471 t of crop residues (cereal stalks, peanut leaves/hay, cowpea leaves and cotton cake) for payments totaling FCFA 284,380 for the grinding services. Also, 131 women participated in the production of fodder crops sown on 81.25 ha (45.75 ha of cowpea, 25, 50 ha of sorghum, 5.50 ha of *Mucuna*; 2.75 ha of *Brachiaria* and 1.75 ha of groundnuts). In 12 Sikasso target communes under AMEDD oversight, four women livestock producers out of 12 participants were trained to become trainers of other farmers. A total of 1,096 farmers were in turn trained, including 383 women.

Note that the security conditions in the Mopti Region were not favourable for women moving from one village to another (sequel to the traffic ban of motorcycles and pick-up vehicles) nor for women and men joining together for common activities. In some villages, men's activities were also curtailed. CRS continued to provide education for project staff and beneficiaries regarding gender equality. In this context, frequent assessments of staff understanding of gender issues occurred in order to quantitatively and qualitatively improve program outcomes with regard to women's involvement.

One important aspect of women's empowerment dealt with the vaccination of sheep and goats which are livestock assets mainly owned by women. Only 5% of sheep and goats were vaccinated against PPR at basline. The establishment of IPs promoted the involvement of women in all project

interventions and to specifically benefit from them. By the third year of project implementation, 75% of sheep and goats had received PPR vaccination. (Table 15)

Table 15. Indicators with target and actual results and comments

Activity	Results	Indicators	2018		Comments
			Target	Actual	
Objective 1. To promote innovative animal health delivery systems and facilitate the implementation of best health interventions to reduce disease burden in ruminant livestock					
1.1 Produce and deliver a thermostable vaccine against PPR	A PPR thermostable vaccine is available	Control tests on quality of PPR thermostable vaccine	2	2	The two thermostable PPR vaccines have passed both internal (LCV) and external (AU-PANVAC) control tests
	Reduction in costs of PPR eradication campaigns and vaccinations are more effective	No. of doses of vaccines produced	400,000	120,000	The 2018 batch was produced with a revised lyophilization protocol that could reduce the residual moisture content, hence the limited number of doses produced.
1.2 Support the prevention of ruminant livestock major epidemic diseases	Reduced death and morbidity losses in cattle, sheep and goats	No. of farmers who have vaccinated small ruminants against PPR using thermostable vaccine	22,300	10,009	The new PPR thermostable vaccine has not been used yet. Its planned use in FY19 will cover all small stock in target communes. This current figure refers to the use of classical PPR vaccine. However, the vaccination coverage reached in FY18 was 75%. This reflects the overestimation of targets.
		No. of farmers who have vaccinated small ruminants against pasteurellosis	11,700	1,464	There was a shortage of vaccines at the time of vaccination. In addition, targets have been overestimated.
		No. of farmers who have vaccinated cattle against CBPP	11,000	4,130	Producers tend to pool their individual flocks for vaccination. Targets have also been overestimated.
		No. of farmers who have vaccinated cattle against Pasteurellosis	11,000	1,808	There was a shortage of vaccines.

Activity	Results	Indicators	2018		Comments
			Target	Actual	
1.3 Facilitate the formation and operation of Community Animal Health Platforms (CAHP)	Improved business environment of animal health service delivery systems, improved capacity of livestock producers, improved access to vet inputs and services, better organized vaccination campaigns	No. of CAHP established	0	0	They did not have any new IP creation. The IP of the new municipality of CRS (Madiama) is not yet in established.
		No. of IP meetings	150	130	At first, IP meetings were subdued and infrequent. Now, IP members are confident and hold frequent meetings.
1.4 Improve producers and CAHWs technical knowledge and skills to facilitate the uptake of selected animal health measures	Increased uptake of technologies that control endemic diseases	No. of training of trainers courses organized			The number of trainees on integrated packages with a large animal health component is not taken into account here.
		No. of farmers trained on ways to control endemic diseases	4,000	2,697	
		No. farmers trained on rational drug use	4,000	2,697	
		No. of farmers trained on control of mastitis, milking hygiene, milk handling and pasteurization	4,000	2,697	
Objective 2. To increase availability of quality feed biomass, and to improve on farm-feed utilization and husbandry practices to support ruminant livestock productivity gains					

Activity	Results	Indicators	2018		Comments
			Target	Actual	
2.2 Facilitate the upscaling of improved legume and cereal food feed crops cultivars (cowpea, sorghum, millet) and forage species (Brachiaria and bourgou)	Improved awareness on multipurpose crop varieties and forage species, improved availability of quality feed biomass, knowledge on feed market opportunities	No. producers trained on fodder and forage production	6,000	13,751	
		No. producers who adopted fodder crops	15,200	ND	To be determined by the results of the annual survey.
		No. ha under improved fodder varieties	4,000	2,099	Surface area planted with sweet sorghum, double-purpose cowpea and groundnut introduced by the project. Seed supply has been a major constraint to the expansion of surface area planted.
		No. ha under forage production	2,000	1,007	This overrun is explained by the growing preference for pure forage crops (Brachiaria and Bourgou, Mucuna). Shortage of seed supply limited the surface area planted.
2.3 Promote the upscaling of integrated packages for improved cattle, sheep and goat productivity	Intensified cattle and sheep production models are promoted	No. farmers trained on intensified cattle, sheep and production models	700	1,644	
		No. of farmers who have adopted cattle intensified production models	400		To be determined by the results of the annual survey.
		No. of farmers who adopted sheep and goat intensified production models	2,000		To be determined by the results of the annual survey.
2.4 Develop capacity of producers and promote the consolidation or establishment of private small-scale feed manufacturers	Increased feed market opportunities, improved feed transferability	No. of youth and women trained on feed processing	200	92	This figure only indicates the number of women. We do not have data for young people. This large gap can be explained by the increase in the number of villages and beneficiaries.
		No. of small feed manufacturing enterprises that have received business development services	20	5	
Objective 3. To leverage existing USAID-led livestock market development and policy initiatives in support to the upscaling of productivity enhancing technologies					

Activity	Results	Indicators	2018		Comments
			Target	Actual	
3.1. LMIS is revitalized to capture market incentives	Better access to real-time market information by a larger number of farmers and market agents	No. of enumerators trained on LMIS	17	16	Due to insecurity in the Mopti Region, the Mougna market is no longer monitored by the collector. When the situation is safer, we will resume monitoring this market.
		No. of users of LMIS	10,000	12,620	With the support of the two projects FTF-MLTS and PRAPS, the number of users is increasing.
		No. of professional using LMIS	1,000	2,000	The number of professionals using LMIS is increasing due to the two projects, FTF-MLTS and PRAPS.
		No. professionals trained on LMIS	1,500		The training of the 200 professionals is planned for the near future.
3.2. Facilitate the development a competitive cattle and sheep production and marketing model	Increased volume and value of marketed animals, improved business and technical capacities of feedlot managers	No. of cattle and sheep fattening platforms put in place			The concept of sheep and cattle fattening platforms did not materialize during project implementation. We propose to review indicators for this activity.
		No. of fatteners in the platforms			

Synergic activities achieved with other partners

The FTF-MLTS program engaged with other USAID FTF programs and the private sector in Mali to develop solid partnerships required to achieve program goals.

FFSWE. FTP-MLTS and FFSWE held regular meetings to find ways to facilitate access to bank credit for livestock value chain players (fatteners, breeders, groups of women, private veterinarians and feed manufacturers). Candidates for bank credit have been identified among fatteners and private veterinarians who indicated the loan amounts they need. Financial intermediaries based at Sikasso helped loan candidates to prepare and submit their business plans and loan applications.

Food for Peace (Harande). ILRI and Foodd for Peace (Harande) entered into an agreement with a budget of USD290,000 that enabled ILRI to scale up livelihoods diversification and resilience best practices developed by ILRI into the Harande ZOI. During FY18, ILRI established IPs in two Harande target communes to roll out animal health and feed technologies to improve the productivity of small ruminants and poultry. The concept of 'One health' was applied by ILRI in Harande target communes. Furthermore, all extension materials have been digitalized and will be accessible by all project beneficiaries through a call centre.

Texas A&M and L4G and other partners: ILRI continued collaborative work with Texas A&M University for the upgrade of LMIS. LMIS Version 4 was developed and uploaded by Texas A&M (see details section previous report section on LMIS). Following various consultations among partners (L4G, MLTSP, SVN, OMA, PRAPS), and under the leadership of USAID, a working group on LMIS was set up and held a series of consultations. The emerging idea is the development and coordination among all partners of a single sustainable Mali LMIS under the management of OMA.

Challenges and anticipated solutions

- Beginning on 2 February 2018, the Mali Army forbade the use motorcycles of any kind and pick-up trucks in some areas in the Regions of Mopti, Timbuktu and Ségou and particularly in the areas of project intervention. This sought to ensure better protection of the population as well as their environment. That decision has, however, adversely affected the movement of people. For CRS, the alternative strategy has been to use Prado vehicles for the activities of monitoring and supervision with often renting vehicles when needed. This has resulted in the reduction of the frequency of field monitoring activities. In addition, this has led to an overspending on budget lines allocated to field mission activities.
- In the Region of Mopti, during night visits to community leaders, radical groups threaten villagers, abuse women and prohibit the gathering of men and women. Faced with this situation, CRS has adapted its approach to Farmers Field School at the community level. Producer-trainers are trained during theoretical intensive sessions at local commune level on target technologies and on their role and responsibilities in the upscaling of technologies. The training modules included technologies on production of dual-purpose sorghum, cowpea and groundnut, and of Bourgou. During these sessions of restitution, the trainers often receive the supervision of agents of the Direction Regionale de l'Agriculture (DRA) and the DNPIA. These trainer-producers remain a potential to support the project in the dissemination of information on these technologies and the monitoring of the project interventions in their respective villages. This approach is beneficial to the sustainability of project interventions.
- The major constraint to access to credit lines for the benefit of livestock keepers is that financial institutions do not see the livestock industry as credit worthy. In addition, the timing of the repayment of the credit requested by financial institutions is incompatible with the livestock production and marketing cycles. In particular, to start paying the loan as early as the first month is not suitable for the activity of fattening. It should also be noted that the geographical range of operations of institutions of micro finance (less than 15 km) is a constraint on the funding of the fatteners located beyond the delineated area.
- How to ensure sufficient production of seeds of *Brachiaria* and make them available to producers at an acceptable price is a challenge that will be further addressed by FTF-MLTS in the future. The development of contractual arrangements between Laham Industrie and fatteners in project target communes is also still a challenge that will attract further investment in the future.
- FTF-MLTS will finds ways to ensure the functionality of the IPs so that they can play their full role in the achievement of the results of the project (low level of literacy, weak mobilization of resources for their operation). Les plateformes d'innovation sont utiles à la durabilité des acquis du projet mais elles n'ont pas de statut juridique pouvant asseoir leur reconnaissance institutionnelle.
- Access to land by women is also seen as an impediment to their large adoption of fodder and forage crops production technologies.

Success Stories

The new drive of Hamadi Tangara to diversify his income and embark in a livestock business has been the result of his involvement in FTF-MLTS.

Hamadi Tangara in his fattening workshop, Mandio. Photo, Housseyni Kokena, Project supervisor CRS/CRS, 02/02/18

Mr Hamadi Tangara is a married (polygamist) agro-pastoralist and father of nine children. He is a beneficiary of the FTF-MLTS program, a resident of Mandio in the 'commune' of Sio, 'cercle' of Mopti. Before FTF-MLTS, Mr Tangara was a middleman, buying and selling livestock at the livestock Somadougou market, 'commune' of Sio, for many years without any interest in livestock fattening. In 2017, the village of Mandio became one of the communities covered by FTF-MLTS. Mr Tangara was selected by the community to be trained by FTF-MLT to become a farmers' trainer. He is in charge of communication activities within the IP of the target commune of Sio. Mr Tangara benefited from dual-purpose varieties of cowpeas and groundnuts. He was also one of the participants of training sessions on different forage production techniques and on forage post-harvest management promoted by FTF-MLTS and on the development of business plans.

During his interview, he said:

It is my participation in the MLTSP project that strongly encouraged me to go into cattle fattening. Having received seeds (cowpeas and groundnuts) early in the growing season and applying the techniques as advised by the project extension agents allowed me to have a significant amount of fodder. This triggered my decision to start fattening activities.

After my participation in the workshop on the development of business plan organized by the project, I studied the feasibility of a fattening project. I became more aware of the relevance and profitability of this business. Thus, in February 2018, I bought three cattle (oxen, bulls) and built a fattening habitat in my compound. With the fodder from the dual-purpose cowpea and groundnuts I produced on-farm, I had sufficient feedstuff to fatten the three cattle I purchased. After three months, I intend to sell them at the market and I'm sure I can make a profit of more than FCFA 330,000, because I know that on the market, I can earn at least FCFA 850,000, compared to investment which will not exceed FCFA 520,000 [purchase of three oxen at FCFA 305,000 and other charges including fodder, salt, cake, vaccines FCFA 215,000).

Alassane Dicko is a fattener from the Kouoro Barrage IP, 80 km north of Sikasso on the RN11. He runs two types of fattening: 1) fattening with continuous confinement in the dry season and 2) fattening on natural grazing during the rainy season. During the last three years, he produced 216 head of cattle in the intensive dry season fattening and 120 heads (100 cows and 20 bulls) in the rainy season. He purchases lean animals from domestic markets such as Fatoma and exports the well finished products in Côte d'Ivoire (San Pedro). His average benefit is FCFA30,000 per head from natural grassland production, against FCFA60,000 from the intensive dry season fattening. He has three permanent employees, but due to his business going to scale with the increase in the number of animals being fattened, he has added three temporary employees. He has three enclosures, a store to keep concentrates and sheds to store crop residues and harvested roughages from natural pastures. Due to his reliability, his availability and his perseverance, his business has met with great success. He received advice from the project on animal health and ways to conduct fattening workshops. He was linked to the FFSWE project for the development of his business plan and guidance on his credit application. FFSWE helped him link up with MicroCred to finance his activities. Main outcomes of his livestock fattening businesses include (1) better knowledge and skills in running a fattening workshop, (2) income improvement and (3) keeping records of fattening operations. 'Before participating in the project, I did not give enough importance to keeping records of my operations (ex: prices, inputs, outputs) but with the guidance of the project, I now record all details of my operations, which allows me to know at any time the status of my purchases, sales and profit.

Alassane Dicko, cattle fattener, Kouoro

Alassane Dicko's fattening workshop

Lessons learned

- IPs have proved to be useful mechanisms for the engagement among multiple value chain actors and local authorities that facilitated the roll out of project interventions. In particular, IPs enabled the design and implementation of the participatory planning, execution and evaluation of vaccination campaigns with significance in terms of increased number of cattle, sheep and goats being protected against key killer epidemic diseases such as CBPP, bovine and ovine pasteurellosis and PPR.
- Producers are willing to participate to vaccination, contrary to the perception of veterinarians. The main reasons producers refuse to take their animals for vaccination are: self-medication (39%), recall of a deterrent event such as death of an animal following vaccination (15%), remoteness and lack of vaccination park (13%), lack of information about vaccination calendars (8%), poor service given by an animal health worker (6%), and the high cost of vaccination (5%). The WTP was high and ranged between FCFA 150 and 300 per dose for more than 80% of producers regardless of the proposed attribute (distance or quality of the vaccine).
- Strong commune leadership is essential if the project is to be successful at the community level. The adhesion of and support from new target commune leaders have greatly facilitated village consultations that have resulted in an increased awareness of the community members on the FTF- MLTS program objectives and implementation strategies and this has been a key to rolling out project interventions.
- There is a strong demand from farmers for the production of fodder from *Brachiaria*. Among the four *Brachiaria* varieties that were introduced in target communes by FTF-MLTS (ruziziensis, xaraes, piata, basilisk), the ruziziensis variety is preferred by producers due to its superior production of biomass (up to 20 t/ha). The basilisk is early, according to the producers, but its biomass production is low compared to other varieties. Groundnut cultivars were especially preferred by women for the quality of its seed. However, due to their early harvest period, it is difficult to conserve vines as animal feed particularly in the area of Sikasso (rain and lack of barns).
- To further make forage production sustainable, it will be imperative to select champion farmers and empower them to become professional specialized seed producers. FTF-MLTS is working on this.
- The recovery of degraded abandoned areas for the production of Bourgou has created opportunities for renewal of the fauna and flora (return of some species of fish and waterfowl) and can thus be an additional incentive for communities to further invest in forage production. The accountability of the community leaders in the management and recovery of seeds has been a key factor in the repayment of the seeds.
- The dynamics of the cattle market in Mali have changed with the presence of Laham. Laham is a modern Halal abattoir established in Kayes near the Mali-Senegal border. Laham seeks to source fattened animals, either from local pastoralists or later through the establishment of its own feedlot, for processing and export to Senegal and back to Bamako for higher-end markets. However, Laham has had difficulties in procuring sufficient volumes of animals, with focus group discussions with pastoralists and traders revealing a reluctance to sell to Laham because of perceived low offering price. Laham has also had difficulties with sufficient cash flow, with payments from buyers often delayed for up to six months. As a result, while Laham has a capacity of 300 cattle slaughtered per day and a commercial target of 100 cattle per

day, it currently only slaughters 500-600 cattle per month in five to seven batches per month. Current sales (based on focus group discussions in December 2017) are 60 t per month, with half sold to Senegal to high-end buyers (caterers, hotels) and the remainder to franchises, hotels, restaurants and mining operations in Bamako. Sales to Senegal go in refrigerated trucks, and there is the potential (though not confirmed) of exploring the profitability of making money on backhaul of fresh seafood, poultry and vegetables from Senegal to Mali.

- Laham's influence on the market in Mali is important. Its medium-term viability, however, is less clear. In domestic markets, Fadiga (2018) outlines a high-value strategy aimed at hotels, restaurants and higher-end consumers in Bamako and whose market size was estimated at 6,793 t of beef per year. Achieving a market share of 30% in that segment would necessitate an annual slaughter of 9,398 animals, or 43 cattle per day, well within the capacity of Laham (and still well short of its target of 100 animals per day). Furthermore, Laham is about to develop a feedlot to secure its supply and improve the condition of animals it sells. On the other hand, competition in the Senegalese market is likely to become even more fierce with the current construction of an Indian-funded abattoir near the new Dakar airport with a 50,000 t annual capacity, several times that of Laham. As that abattoir would likely source from traditional live-animal markets (whether Senegalese, Malian or Mauritanian animals) an important question is whether Laham can develop an appropriate, compelling value proposition for consumers in Dakar, and/or alternative markets for its meat. Its location at Kayes hems it into the Senegalese market, with logistics to international markets further south more problematic. There are also potential logistical issues with remaining competitive in its feedlot strategy, in terms of the costs of procuring feed from other parts of Mali, as well as finding enough quality animals to finish on quality rations.

Environmental risk mitigation activities

- During the training of trainers and training of producers on forage crop techniques, there is always a reminder on disposal of empty packages of pesticides. Participants in training courses were advised to store empty packages in safe places for protection of the environment. Awareness raising also continued during the monitoring of forage and fodder plots. A total of 12 sessions were conducted and 712 producers were informed about environmental risks.
- Cowpea, sorghum and groundnut varieties currently promoted in the Mopti project target communes that have been chosen because they have a relatively short production cycle and do not require much water. They fit well in the climate condition in the Region of Mopti that records low rainfall and short rainy seasons. Popular local varietal are also used by the project in two communities (Emba Dendi and Emba Greoue).
- According to fertilizer provisions set out in the technical fertilizer data sheet (USAID/AFR), during demonstration sessions in Farmers Field Schools, producers are informed on secure fertilizer (urea and DAP) and pesticides (Decis 25EC and Apron star) storage and handling measures in order to minimize the risk to them and on the environment. They also have equipment such as gloves, scarf and treatment devices they use during the use of the product. Apart from its use, the process of elimination of residues of packages underground and outside the fields has also been detailed to producers.
- FTF-MLTS promotes good practices such as the techniques of production and use of compost, the preservation of tree seedlings in the field, the conservation of seeds, the rational use of fertilizers (micro-dose) and the use of the apron star (protect seedlings against the birds without killing them) and the measures of protection and management of packages. These good practices remain consistent with the environmental guidelines of USAID for activities on a small scale in Africa, EGSSAA. The document of the 2014 approved PERSUAP is distributed to extension agents. On Bourgou plots, farmers have reported the return of some species of fish and birds that had almost disappeared from the area. These include Heterotis niloticus (Fana) which is a variety of fish and Anas querquedilas (Dougoudougou or Sarcel of summer), a variety of bird.

Annexe 1. Vaccine quality control test report from AU-PANVAC

AFRICAN UNION
الاتحاد الأفريقي

UNION AFRICAINE
UNIÃO AFRICANA

PAN AFRICAN VETERINARY VACCINE CENTRE
CENTRE PANAFRICAIN DES VACCINS VETERINAIRES
AU-PANVAC

Debre Zeit, ETHIOPIA P. O. Box 1746 Telephone : +251 11 433 8001 Fax: +251 11 433 8844
E-mail: aupanvac@africa-union.org

OIE collaborating Center for Quality Control of Veterinary Vaccines

FAO Reference Centre for Technical Assistance in Quality Control of Veterinary Vaccines

VACCINE QUALITY CONTROL TEST REPORT

Quality Control Report Number: QCR 942 *Date: 25th September, 2018*

Name and Address of Manufacturer: Laboratoire Central Vétérinaire, Mali

Vaccine Type: PPR (OVIPESTE)	**PANVAC REFERENCE NO: P243/711/32/18**	**Date of sample shipment:**	**Date of sample receipt: 24/08/2018**
Batch Number: 75	**Date of Manufacture: 05/2018**		**Number of vials submitted: 20**

S/N	TEST CONDUCTED		METHOD USED	RESULTS OBTAINED	REFERENCE VALUES	OPINION/ INTERPRETATION
1.	STERILITY	Bacteria/fungi	Culture FTG/TSB	No growth obtained	Absence of growth	Pass
		Mycoplasma contamination	Classical PCR	No identical band obtained	Absence of identical band	Pass
		BVD contamination	BVD Real time PCR	No identical amplification plot obtained	Absence of amplification plot	Pass
2.	SAFETY	In laboratory Animals	Inoculation in mice	No adverse reactions observed	Absence of adverse reactions	Pass
3.	POTENCY	*In-Vitro*	Titration on Vero cells	$10^{3.5}$ $TCID_{50}$	$\geq 10^{2.5} TCID_{50}$	Pass
4.	IDENTITY	PPR	One step RT-PCR	Identical band obtained	Presence of identical band	Pass
5.	STABILITY	Vacuum	Spark tester	Violet light observed	Presence of violet light	Pass
		Residual Moisture	Thermo-gravimetric	2.0 %	≤ 3.5%	Pass

PP Dr. Nick Nwankpa
Director, AU-PANVAC

AFRICAN UNION - PANVAC - PANAFRICAN VETERINARY VACCINE CENTRE

Version No 2 AU-PANVAC/OMS/QF/037

www.feedthefuture.gov